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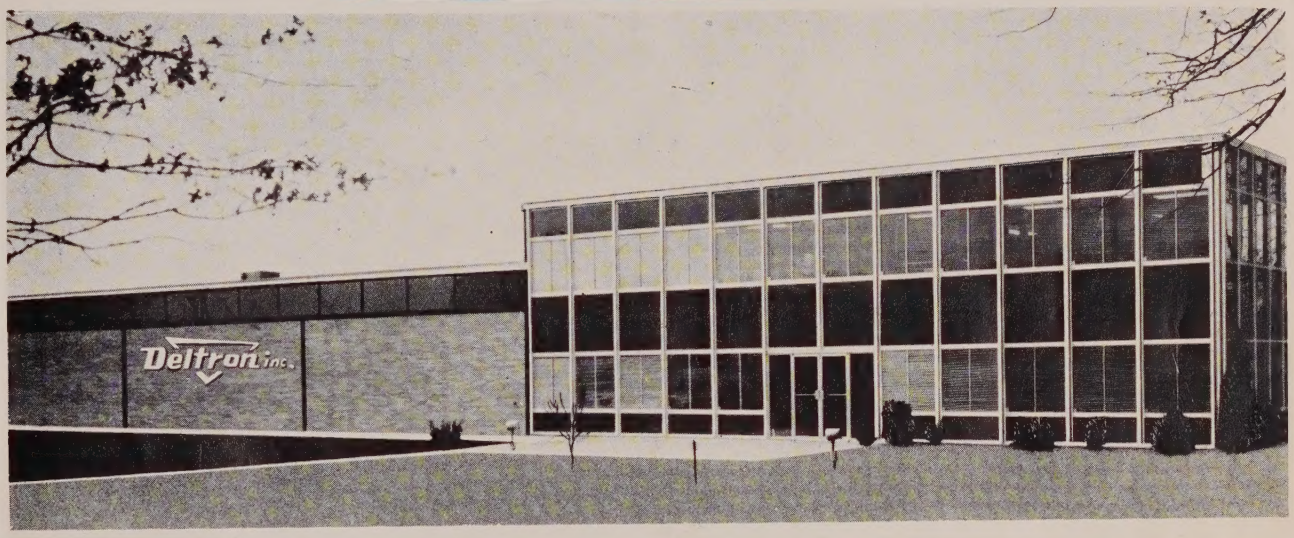
Deltron inc.



QUALITY ASSURANCE
STANDARDS, CALIBRATION, AND
MAINTENANCE LAB.

SP 40-2.5

INSTRUCTION MANUAL

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1.0 Description

Deltron SP Series are high precision, continuously adjustable laboratory power supplies. They feature DUET twin amplifier (which controls voltage or current with automatic crossover to either mode) and deliver a large amount of highly controlled power from a small package by use of an exclusive fast response, non-dissipative pre-regulator. The automatic crossover feature makes it possible to parallel units without any special connections.

The output voltage an current are remotely programmable over their entire range. Remote sensing to compensate for drops in load feeder lines is also provided. Voltage and current are remotely programmable by resistance, voltage, or current.

Both output voltage and current are adjustable by means of concentric coarse and fine controls.

2.0 Specifications

Line Regulation

Constant voltage	Less than 0.005% + 500 μv
Constant current	Less than 0.005% + 500 I μa

Load Regulation

Constant voltage	Less than 0.005% + 500 μv
Constant current	Less than 0.005% + 500 I μa

Ripple & Noise

Constant voltage	Less than 500 μv rms
Constant current	Less than 500 I μa rms

Stability

Constant voltage	Less than 0.05% + 2 mv	Maximum deviation from median for 8 hours after warm-up of 4 time constants
Constant current	Less than 0.1% + 2 I ma	

Temperature Coefficient

Constant voltage	Less than 0.01% + 500 μv/°C	Averaged over rated temperature range
Constant current	Less than 0.05% + 500 I μa/°C	

Where I = maximum rated current

Specifications for constant current mode are percentages of the maximum rated current of the particular model.

Resolution

Constant voltage	Better than 0.005%
Constant current	Better than 0.005%

Input

105 - 125 volts AC 50 to 65 cps.

Recovery Time

Less than 50 microseconds to within 10 mv of final value after full line change or 100% load increase.

Operating Temperature

71°C max. Multiply current by factor shown for temperatures above 50°C

Temp.	60°C	71°C
Factor	0.85	0.7

NOTE: All specifications measured at rear terminals

3.0 Remote Programming Constants

Voltage Programming Constants $= \frac{40000}{E}$ $\frac{\text{Ohms}}{\text{Volts}}$

Current Programming Constant $= \frac{2000}{I}$ $\frac{\text{Ohms}}{\text{Amp}}$

4.0 Operating Procedure

CAUTION: It is imperative that both positive and negative sensing connections be made before energizing the power supply. Since this unit is convection cooled, it is necessary to provide clearance for air to pass vertically through the heat sink compartment.

Connect 115V AC 50 to 65 Hz. to the input terminals of the power supply. Turn the current control clockwise and turn on the main power switch. The voltage can now be raised or lowered by means of the voltage control. Place a load on the supply and note as the current control is turned counter-clockwise the voltage will start to drop and the unit is under current control.

As the current control reaches minimum, the voltage will drop to zero. If it appears the unit isn't working, check that the current control is not fully counter-clockwise. This is a shut-off condition.

By removing links and changing connections on the rear terminal borad, various operating modes can be used which are listed below.

4.1 Voltage Regulating Modes

4.1a Local Sense, Local Control

For this mode of operation, shorting links must be placed between rear terminals S- & B-, B+ & S+, S+ & V+, and I & N. Output is to be taken from B+ & B- of the rear connections; or from the front binding post/jacks as desired.

4.1b Local Control, Remote Sense

Links must be connected between rear terminals S+ & V+, and I & N. Two light gage wires must be connected; one from S+ to the positive side of the load and the other from S- to the negative side of the load.

4.1c Remote Control, Local Sense

Programming resistors are connected between rear terminals V- & B- and are chosen to correspond to the values given in Section 3. Links must be in place between rear terminals B+ & S+, S+ & V+, and I & N.

4.1d Remote Control, Remote Sense

The external programming resistors are connected between rear terminal V- and the negative side of the load. Links are connected between S+ & V+, I & N. A light gage wire must be connected from S+ to the positive side of the load.

4.2 Current Regulating Modes

4.2a Local Control

Links must be connected between rear terminals S- & B-, B+ & S+. S+ & V+, and I & N. Current adjustment is then made by the front panel controls and is limited to a maximum of slightly more than the full load rating of the range being used.

4.2b Remote Resistance Programming

Links are placed between rear terminals S- & B-, B+ & S+ and S+ & V+. A programming resistor is connected between N & I, and the concentric coarse and fine current adjusting controls of the power supply are turned to their extreme counter-clockwise positions.

4.3 Combined Voltage and Current Operation

All of the operating modes described for voltage and current regulation can be intermixed since the power supply transfers automatically from constant voltage to constant current or vice-versa.

The supply is a variable voltage unit with automatic current limiting or is a constant current source with automatic voltage limiting.

Short circuit conditions are handled by the automatic transfer into current regulation mode.

As a constant current source, the regulating circuits are sensing the currents drawn by the panel voltmeter in addition to the load current. This current is significant when the output current is low or when the highest regulating accuracy is needed. The meter draws 1 ma. for full scale deflection, and its effect can be removed by changing the voltmeter connections. Rear terminals are provided which connect voltmeter positive terminal to the positive sensing output by linking terminals V+ & S+ for most uses. To remove the voltmeter's effect on the current regulation accuracy, the link from terminal V+ may be removed; which leaves the meter inoperative. By connecting terminal V+ to N, the meter is in the circuit and its effect in current regulation is removed, but the meter will show a reading which would be approximately 1 volt high at full load current.

5.0 Circuit Description

5.1 General

Referring to the main schematic drawing, the overall supply operates as follows: The basic controlled DC power is supplied to energy storage capacitor C101 by means of a full wave center-tapped phase controlled rectifier circuit consisting of transformer, T101, SCR'S CR101 and CR102; and capacitor C101.

The capacitor C101 supplies energy to the post-regulator consisting of pass transistors Q101 and drivers Q102 and Q103. The post-regulator consists of these transistors, Amplifier PB101, current-sensing resistor, R109, voltage adjusting potentiometer R110 and current adjusting potentiometer R111. This combined circuit acts to sense a change in the output current or voltage and applies a correcting signal to the base of Q101 to hold the output constant when a line or load change occurs.

The circuit consisting of Q104, R105, R106, CR105 CR106 and C103 is a bleed circuit which draws a constant current to take care of circuit leakage so that the unit will not lose regulation under no-load conditions.

The pre-regulator which consists of the phase controlled rectifier circuit and pre-regulator amplifier PB102 varies the conduction angle so that the voltage on capacitor (C101) tracks the output voltage to keep the power dissipation in the post-regulator series transistor to a low value.

5.2 Post-Regulator

Refer to schematic drawing. A portion of the output voltage is compared with a reference voltage in the amplifier to form an error signal. The error is amplified by the integrated circuits to provide a drive signal for the darlington driver (s) in the series regulator at terminal 2 of the error amplifier. The drive and thus the voltage drop across the regulator adjusts to reduce the error voltage to a few microvolts and thus the output to its regulated value (voltage mode).

A voltage proportional to the output current of the supply is measured across R109 and compared with a reference voltage in the amplifier to form an error signal. The error is amplified by the integrated circuits to provide a drive signal for the

darlington driver (s) in the series regulator at terminal 2 of the error amplifier. The drive and thus the current passed by the regulator adjust to reduce the error voltage to a few microvolts and thus the output current to its regulated value (current mode).

A separate regulated bias supply consisting of an unregulated full wave DC input with capacitor filter, a series regulator and an error amplifier is included on the AR1 error amplifier printed circuit board. This regulated supply provides bias current for the references, the integrated circuit error amplifiers and the drive for the darlington driver in the series regulator.

5.3 Pre-Regulator

Referring to the pre-regulator amplifier (schematic No. C12744) it can be seen that the voltage across the post-amplifier from the B+ terminal to the positive terminal of C101, if fed to input terminal No. 6 & No.1 on PB102. Terminal No. 6 is the circuit common. A signal proportional to output current is fed to terminal No. 2. This signal has a magnitude of one volt for 100% output current. The AC input power is applied to Terminals No. 6 NO. 8, and No. 9 and the firing pulses for the gates of CR101 and CR102 are applied from Terminals No. 3 & 7 and Terminals 4 & 5 The firing pulses vary to produce conduction angles from50 electrical degrees for low power to about 120 electrical degrees for high power conditions.

The circuit associated with Q3, Q4, Q5, and Q6 is the firing pulse circuit. As the voltage on the base of Q3 goes more positive the firing circuit causes phase advance for larger conduction angle. The voltage on the base of Q3 is clamped by CR1 and R8 at some adjusted maximum voltage. This permits setting a maximum limit to the phase advance to prevent half wave firing.

The differential amplifier Q1 and Q2, drives the firing circuit. A positive change on the base of Q1 increases the timing capacitor (C1) voltage. A current advance signal is derived from the current sample resistor R1 and is fed by means of R43, R7 and R1 to the base of Q1. With a sudden increase in load the SCR'S are phased forward a fixed amount proportional to the current change. This is a fast action occurring in less than one-half cycle. If the phase change is not perfect the closed loop control will provide the necessary correction.

Closed loop control is achieved by the additional circuitry associated with Q7 and Q8. A fixed and a variable reference current are fed to the base of Q7 and compared to a feedback signal feed through R21 and R22. The reference current is 0.1 ma. If the feedback current does not balance the reference the voltage on the collector of Q7 changes there by shifting the conduction angle of CR101 and CR102.

Potentiometer R30 provides a signal proportional to load current for boosting the pre-regulated voltage to compensate for the varing ratio of peak to average voltage on capacitor C101 arising from load changes. The pass voltage does not remain constant, in light of this as the pass voltage is a minimum at maximum output current.

6.0 Maintenance and Adjustment

In extremely dusty and oily locations, it would be desirable to clean the unit and wipe oil and dirt off of heat dissipating sections of the supply. This should be done at periodic intervals.

There are seven internal adjustments made at the factory which should not be changed unless the unit is malfunctioning. These adjustments are:

6.1 Post-Regulator Adjustments (Schematic B-13540)

6.1a Current Adjustment (R12) - Place a short on the output and turn the current control to maximum. Adjust R12 so that 105% rated current is taken with the front panel current adjustment in the full CW position.

6.1b Voltage Adjustment (R11) - Increase the voltage control to maximum and adjust R11 for full rated voltage.

6.1c Peak Power Limit (SP 60 & SP 100 only) (R33) - At rated current and voltage, turn R33 until the output voltage starts to drop and back off. If under load change output shows a large downward transient when load is applied, rotate R until undershoot is minimized.

6.2 Pre-Regulator Adjustments (Schematic C-12744)

6.2a Maximum Phase Adjustment (R8)

Disconnect lead to Terminal No. 1, PB102, turn power on and set output voltage control at its maximum. Set input line at 98V AC by means of a variable auto transformer. Place oscilloscope across C101 to monitor DC voltage. Leave on for only short intervals if capacitor voltage exceeds capacitor rating. Apply full load and decrease setting for R8 until half cycle firing occurs, then back-off until half-cycle firing ceases. Do this while heat sink structures are cold as half-cycle firing places an extra stress on SCR'S. Shut unit off and replace lead to Terminal No. 1.

6.2b Current Advance (R7)

The current advance function is to pre-advance the phase when a load change occurs to allow time for the closed loop regulator to preform its correcting function. If the current advance function tracked the load changes perfectly no change would be required in the closed-loop regulator.

To adjust the current advance control set the current potentiometer, R30, to minimum and the Pass Voltage Control R23 half way between the 0 current setting and the 100% current setting shown in Table No. 1. Monitor the voltage from Terminal No. 1 to Terminal No. 6 with an oscilloscope. Apply full load periodically and adjust R7 for minimum undershoots when load is applied. Check at several voltage settings and load currents. Do not advance the current potentiometer too far as undesirable overshoots can occur.

6.2c Pass voltage Command (R23)

Place an accurate voltmeter from B+ output to + of C101 and adjust R23 so that the 0 current setting in Table No. 1, Page 9 is obtained. This is at zero current output. Allow ample time for the capacitor C101 to assume its control value.

6.2d Current Command (R30)

After R23 is adjusted, apply full load current to the supply and again measure the voltage from B+ output to + of capacitor C101. Increase setting of R30 until pass voltage drops to full load value shown in Table No. 1, Page 9.

7.0 General Trouble Shooting

In trouble shooting an SP type power supply, the trouble should first be isolated to the post-regulator or pre-regulator. If no output or inadequate output is obtained, the trouble is probably an inadequate capability of the post-regulator; the starvation of the post-regulator due to an inadequate capability of the pre-regulator; or an over loaded output.

Another type of trouble that can exist is one in which a primary trouble causes other circuitry to overload. An example would be a pass transistor failure turning the pre-regulator to full power. If a low resistance load were connected to the output, the pre-regulator would be overloaded.

If the unit cannot be turned on due to an overload on the primary line, remove the pre-regulator card. This will stop the SCR action. If the short persists, the faulty component most probably can be found among the input components consisting of: CR101, CR102, or C101. Replace the defective component and re-energize the supply. If the overload is gone, the pre-regulator card may be replaced. Before turning on power check across C102 for a short. Also check across pass transistors Q101. Remove the output load and turn supply on. If supply does not regulate the trouble lies within post-regulator circuit.

A thermostat is provided for protection against high ambient temperature conditions. If the output cannot be loaded down after being on for more than an hour and the unit recovers after being off for a short period the thermostat may have operated. It by-passes the drive to transistor Q103 when it reaches 140°C. Check to see that adequate ventilation is provided. The top and bottom of unit should not be blocked as the unit is convection cooled.

Due to the nature of integrated circuits and the necessary close proximity of conductors on the printed circuit board, it is recommended that field repairs to the error amplifier not be attempted. If there is no output from the power supply and connector point 2 at the error amplifier connector is not positive with respect to connector point 1; if there is high, unregulated output from the power supply and connector point 2 is a volt or two positive with respect to connector point 1 (base of first darlington driver positive with respect to S+); or if the bias voltages in the error amplifier do not correspond, it is recommended that the error amplifier be replaced with one known to be operable. If the 28 volt input voltage across C1 (error amplifier) is not present, check C1, CR1 or CR2 on the post-regulator printed circuit board for short circuits.

When a malfunction occurs, it may cause subsequent damage to other components in the supply, so it is good practice to check these as well. A visual inspection is also recommended to detect burned out parts. On a routine basis, it is sufficient to keep the unit clean and free from obstructions.

8.0 Multiple Power Supply Interconnections

The self protecting type circuitry featured by this power supply makes possible to series stack outputs (up to a maximum of 350 volts, circuit to chassis) as a useful and safe configuration. There are additional operating performance dividends associated with such useage such as are described below.

When used in series operation the maximum current that can be taken is limited by the model with the lowest current rating. For the best performance in current mode all the supplies in series must be adjusted for the same limit in current.

The remote sensing connections for a series group of supplies would be made by running sensing leads from the two extreme voltage points of the system, to the respective load terminals; using the linkage and terminal arrangements described previously.

When used in parallel operation the maximum voltage that can be set is limited by the model with the lowest voltage rating. For the best performance in voltage mode all the supplies in parallel must be adjusted for the same voltage level.

For use in Master-Slave one knob control, in either series or parallel operation, see connection diagrams for Master-Slave Operation.

SERVICE

For repair service or special operating instructions, contact the factory where complete facilities and trained personnel are available for your assistance. Please furnish power supply model and serial numbers along with a detailed description of the problem encountered in any correspondence with the factory. Repairs not covered by warranty will be billed at cost. An estimate will be forwarded for approval on request.

REPLACEMENT PARTS

Special and standard components used in all Deltron equipment may be obtained from the factory. When ordering these parts, the following information is required: (1) Model and Serial No. of Power Supply, (2) Date Purchased, (3) Deltron Part No. or Manufacturer and Part No., (4) Parts list sheet, item and group no. or circuit designation and drawing no., and (5) Complete description, designation, and location of the part in the supply, if the part is not listed in parts list or drawing.

TABLE NO. 1

This table lists pass voltages measured from B+ output to C101 + for no load and full load conditions.

UNIT	NO LOAD VOLTAGE (Volts)	FULL LOAD VOLTAGE (Volts)
SP 10-5	10	5
SP 10-10	10	5
SP 10-15	12	6.3
SP 10-20	12	6.3
SP 10-25	12	6.3
SP 10-30	12	7
SP 10-40	9.5	5.5
SP 10-50	10	5.7
SP 20-5	12	7
SP 20-10	12	7
SP 20-15	12	7
SP 20-20	11.3	6.3
SP 20-25	11.5	7
SP 20-30	10.1	6.1
SP 20-50	10.5	6.5
SP 40-2.5	10	7
SP 40-5	10	7
SP 40-10	10	7
SP 40-15	10	8
SP 40-20	10	8
SP 40-25	10	7
SP 40-30	10	5.5
SP 60-2.5	14	8.5
SP 60-5	15	10
SP 60-10	15	10
SP 60-15	15	10
SP 60-20	15	10
SP 100-1	18	10
SP 100-2	18	10
SP 100-3	18	10
SP 100-4	15	10
SP 100-8	25	16
SP 100-12	18	10.5

ELECTRICAL PARTS LIST
FOR
SP 40-2.5

ITEM NO.	QTY.	REF. NO.	DESCRIPTION
1	X	D13625	SCHEMATIC
2	1	C101	CAPACITOR, 15,000 µfd, 50V
3	1	C102	CAPACITOR, 500 µfd, 50V
4	1	C103	CAPACITOR, 250 µfd, 25V
5	2	C105	CAPACITOR, CERAMIC DISC, .005 µfd, 1000V
6	R	C106	S/A C105
7	1	C107	CAPACITOR, 50 µfd, 50V
8	1	C108	CAPACITOR, SELECT IN TEST
9	1	C109	CAPACITOR, .01 µf, 400V
10	2	CR101	RECTIFIER, SCR C30G G.E. W/MICA INS. & TEFLON SLEEVE
11	R	CR102	S/A CR101
12	2	CR103	RECTIFIER, 100V, 409B, WEST.
13	R	CR104	S/A CR103
14	2	CR105	RECTIFIER, MH69, SOLITRON
15	R	CR106	S/A CR105
16	1	DS101	PILOT LIGHT, IND.DEV. #2110A1
17	1	F101	FUSE, 6A, BUSSMAN ABC
18	1	M101	METER, BEEDE, 2.5 ADC
19	1	M102	METER, BEEDE, 50 VDC
20	1	P101	LINE CORD, ESSEX #C18674-18/3-SPT-2
21	2	Q101A	TRANSISTOR, 2N3055, RCA
22	R	Q101B	S/A Q101A
23	2	Q102	TRANSISTOR, 40313, RCA
24	R	Q104	S/A Q102
25	5	R101	RESISTOR, 47Ω, 1/2W, 10%
26	R	R102	S/A R101
27	1	R105	RESISTOR, 220Ω, 2W, 10%
28	R	R107A	S/A R101
29	2	R108A	RESISTOR, .5Ω, 5W, WW
30	R	R108B	S/A R108A
31	2	R109A	RESISTOR, 0.83Ω, 5W, WW
32	R	R109B	S/A R109A
33	1	R110 A & B	RESISTOR, VARIABLE, CLAROSTAT, DUAL #CM31610 400Ω, 2W, WW 40K, 2W, WW
34	1	R111 A & B	RESISTOR, VARIABLE, CLAROSTAT, DUAL #CM31611 20Ω, 2W, WW 2K, 2W, WW

5½" Hack Saw

ELECTRICAL PARTS LIST
FOR
SP 40-2.5 CONTINUED

ITEM NO.	QTY.	REF. NO.	DESCRIPTION
35	R	R112	S/A R101
36	1	S101	SWITCH, TOGGLE POWER, CARLING #2FA53, 15A, 125V
37	1	S102	THERMOSTAT, STEMCO TYPE A510, CLOSE ON RISE @ 284°F ± 8°F AND OPEN @ 255°F ± 8°F WITH EXPOSED BIMETAL
38	1	T101	TRANSFORMER, T60110-10
39	1	T102	TRANSFORMER, BIAS, T60197-1
40	1	P50622-503	AMPLIFIER, "K" PB101
41	1	P50309-503	PRE-REGULATOR BOARD, PB102
42	R	R107B	S/A R101

ELECTRICAL PARTS LIST
FOR
"K" AMPLIFIER SP40

ITEM NO.	QTY.	REF. NO.	DESCRIPTION
1	X	B13540	SCHEMATIC
2	1	C1	CAPACITOR, 50 µf, 50V, ILLINOIS ELNA, TYPE T
3	1	C2	CAPACITOR, .02 µf, 500V, CERAMIC, C.I.T. IF REQ'D
4	1	C3	CAPACITOR, 2 µf, 250V, ILLINOIS ICEL MW 5%
5	1	C4	CAPACITOR, .02 µf, 500V, CERAMIC, C.I.T. IF REQ'D
6	X	C5	CAPACITOR, , CERAMIC, S.I.T. IF REQ'D
7	X	C6	CAPACITOR, , CERAMIC, S.I.T. IF REQ'D
8	5	CR1	RECTIFIER, M100G, G.I.
9	R	CR2	S/A CR1
10	1	CR3	DIODE, ZENER, 1N821
11	R	CR4	S/A CR1
12	R	CR5	S/A CR1
13	R	CR6	S/A CR1
14	2	IC1	INTEGRATED CIRCUIT, B13517
15	R	IC2	S/A IC1
16	2	Q1	TRANSISTOR, 2N4061
17	2	Q2	TRANSISTOR, TV66G3
18	1	R1	RESISTOR, 10%, 1/2W, SELECT IN TEST
19	1	R2	RESISTOR, 47K, 10%, 1/2W
20	1	R3	RESISTOR, 4.7K, 10%, 1/2W
21	1	R4	RESISTOR, 12.1K, 1%, 1/2W
22	1	R5	RESISTOR, 16.2K, 1%, 1/2W
23	1	R6	RESISTOR, 681Ω, 1%, 1/2W
24	2	R7	RESISTOR, 120K, 10%, 1/2W
25	1	R8	RESISTOR, 2.7K, 10%, 1/2W
26	1	R9	RESISTOR, 10K, 1%, 1/2W
27	1	R10	RESISTOR, 0Ω,(LINK AWG #22)
28	2	R11	POTENTIOMETER, 5K, AB-NP502M
29	R	R12	S/A R11
30	2	R13	RESISTOR, 14.7K, 1%, 1/2W
31	2	R14	RESISTOR, 33K, 10%, 1/2W
32	1	R15	RESISTOR, 470Ω, 10%, 1/2W, C.I.T. IF REQ'D
33	1	R16	RESISTOR, 10%, 1/2W, USE R16 or 36, S.I.T.
34	1	R17	RESISTOR, 28.7K, 1%, 1/2W
35	R	R18	S/A R7
36	2	R19	RESISTOR, 27K, 10%, 1/2W
37	1	R20	RESISTOR, 470Ω, 10%, 1/2W, C.I.T. IF REQ'D
38	R	R21	S/A R19

ELECTRICAL PARTS LIST
FOR
"K" AMPLIFIER SP40 CONTINUED

ITEM NO.	QTY.	REF. NO.	DESCRIPTION
39	2	R22	RESISTOR, 3.9K, 10%, 1/2W
40	R	R23	S/A R22
41	2	R24	RESISTOR, 10K, 10%, 1/2W
42	R	R25	S/A R24
43	1	R26	RESISTOR, 27Ω, 10%, 1/2W
44	1	R27	RESISTOR, 10%, 1/2W, S.I.T.
45	1	R28	RESISTOR, 10Ω, 10%, 1/2W
46	1	R29	RESISTOR, 10%, 1/2W, S.I.T.
47	R	R30	S/A R13
48	R	R31	S/A R14
49	1	R36	RESISTOR, 10%, 1/2W, USE R36 OR R16, S.I.T.

C.I.T. IF REQ'D - CHANGE IN TEST IF REQUIRED

S.I.T. - SELECT IN TEST

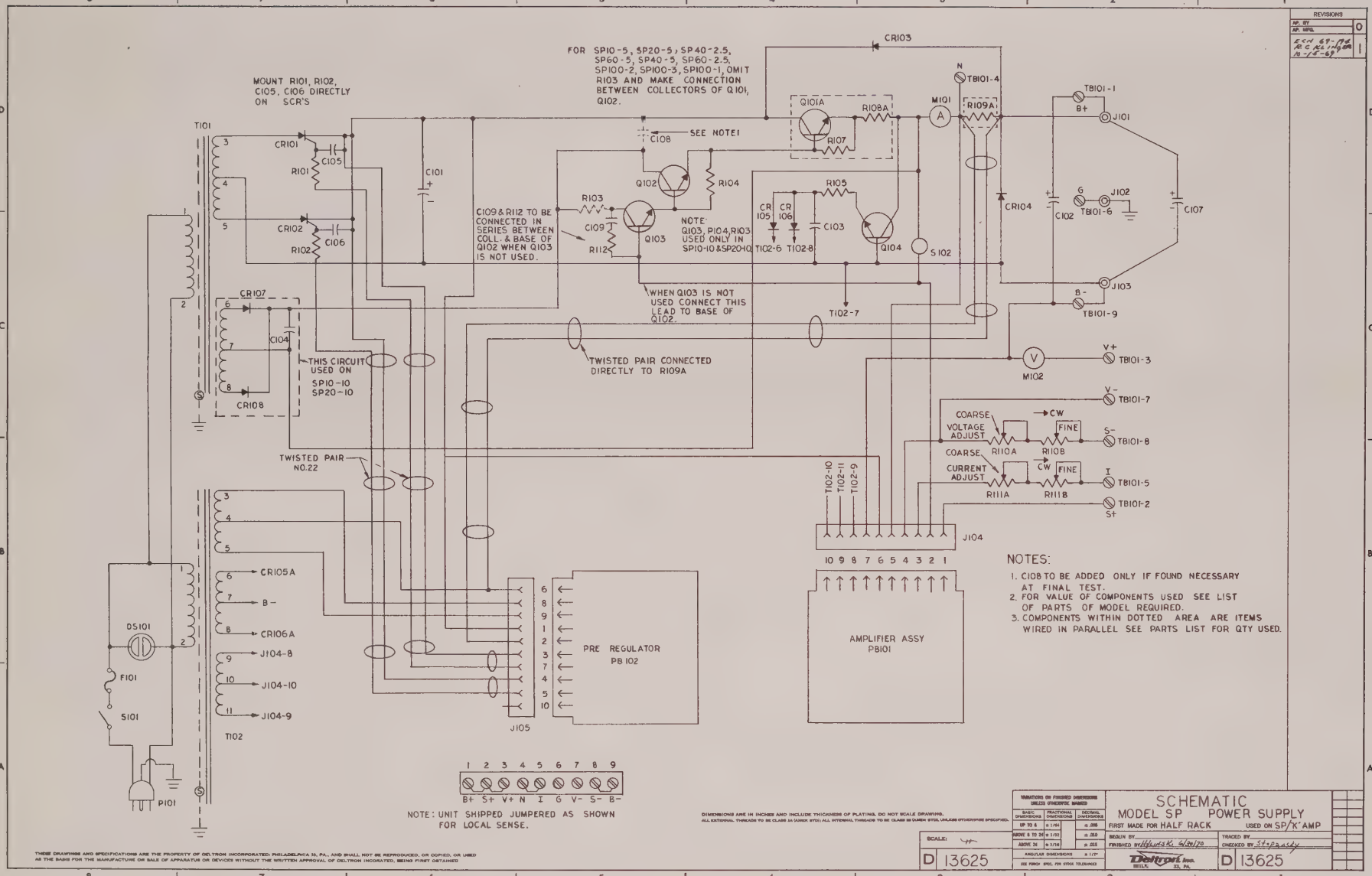
ELECTRICAL PARTS LIST
FOR
SCR PRE-REGULATOR BORAD
SP 40

ITEM NO.	QTY.	REF. NO.	DESCRIPTION
1	X	C12744	SCHEMATIC
2	1	C1	CAPACITOR, .22 µf, 100V
3	2	C2	CAPACITOR, 120 µf, 25V
4	R	C3	S/A C2
5	2	C4	CAPACITOR, 22 µf, 160V
6	R	C5	S/A C4
7	1	C6	CAPACITOR, PAPER, 0.1 µf, 100V
8	1	C7	CAPACITOR, 2 µf, 250V
9	1	C8	CAPACITOR, .500 µf, 25V
10	4	CR1	RECTIFIER, M100G, G.I.
11	R	CR2	S/A CR1
12	R	CR3	S/A CR1
13	R	CR4	S/A CR1
14	2	CR5	DIODE, ZENER, ZA20A, MALLORY
15	5	CR6	RECTIFIER, SILICON, G100G, G.I.
16	R	CR7	S/A CR6
17	R	CR8	S/A CR6
18	R	CR9	S/A CR6
19	R	CR10	S/A CR6
20	R	CR11	S/A CR5
21	1	CR12	DIODE, ZENER, ZA7.5A, MALLORY
** 22	1	CR13	SCR, C106Y2, G.E.
23	4	Q1	TRANSISTOR, TV66G3
24	R	Q2	S/A Q1
25	R	Q3	S/A Q1
26	3	Q4	TRANSISTOR, 2N4061
27	1	Q5	TRANSISTOR, UNIJUNCTION, 2N2646
28	R	Q6	S/A Q1
29	R	Q7	S/A Q4
30	R	Q8	S/A Q4
31	2	R1	RESISTOR, 2.2K, 1/2W, 10%
32	2	R2	RESISTOR, 1K, 1/2W, 10%
33	3	R3	RESISTOR, 47K, 1/2W, 10%
34	R	R4	S/A R3
35	1	R5	RESISTOR, 150K, 1/2W, 10%
36	R	R6	S/A R1
37	2	R7	POTENTIOMETER, 300Ω, 1.5W, WW
38	2	R8	POTENTIOMETER, 10K, 1.5W, WW
39	3	R9	RESISTOR, 22K, 1/2W, 10%
40	1	R10	RESISTOR, 3.3K, 1/2W, 10%
41	1	R11	RESISTOR, 2.61K, 1%, 1/2W
42	1	R12	RESISTOR, 19.6K, 1%, 1/2W

ELECTRICAL PARTS LIST
FOR
SCR PRE-REGULATOR BOARD
SP 40

ITEM NO.	QTY.	REF. NO.	DESCRIPTION
43	1	R13	RESISTOR, 8.25K, 1%,1/2W
44	1	R14	RESISTOR, 150Ω, 1/2W, 10%
45	R	R15	S/A R3
46	2	R16	RESISTOR, 5K, 5W, WW
47	R	R17	S/A R2
48	R	R18	S/A R16
49	1	R19	RESISTOR, 22K, 1W, 10%
50	1	R20	RESISTOR, 27K, 1/2W, 10%
51	2	R21	RESISTOR, 68.1K, 1%, 1/2W
52	R	R22	S/A R21
53	R	R23	S/A R8
54	R	R24	S/A R9
55	1	R25	RESISTOR, 196K, 1%, 1/2W
56	R	R26	S/A R9
57	2	R27	RESISTOR, 10K, 1/2W, 10%
58	1	R28	RESISTOR, 11K, 1/2W, 1%
59	R	R29	S/A R27
60	R	R30	S/A R7
61	1	R31	RESISTOR, 12.1K, 1%, 1/2W
62	1	R32	RESISTOR, 51.1K, 1%, 1/2W
63	1	R33	RESISTOR, 820Ω, 1/2W, 10%
64	1	T1	TRANSFORMER, PULSE, SPRAGUE 11Z25

** C106F2, A2, G2, OR B2 MAY BE SUBSTITUTED



NOTES:

1. C108 TO BE ADDED ONLY IF FOUND NECESSARY AT FINAL TEST.
2. FOR VALUE OF COMPONENTS USED SEE LIST OF PARTS OF MODEL REQUIRED.
3. COMPONENTS WITHIN DOTTED AREA ARE ITEMS WIRED IN PARALLEL SEE PARTS LIST FOR QTY USED.

NOTE: UNIT SHIPPED JUMPERED AS SHOWN FOR LOCAL SENSE.

REVISIONS

AP. BY	0
AP. MFG.	
ECN 69-174 RC 11/19/69 19-15-69	1

SCHEMATIC
MODEL SP POWER SUPPLY
FIRST MADE FOR HALF RACK USED ON SP/K' AMP

SCALE:

D 13625

BEGUN BY
TRACED BY
FINISHED Williams K. 6/30/70
CHECKED BY St+Brasky

Deltron Inc. BUILT 23, PA.

D 13625

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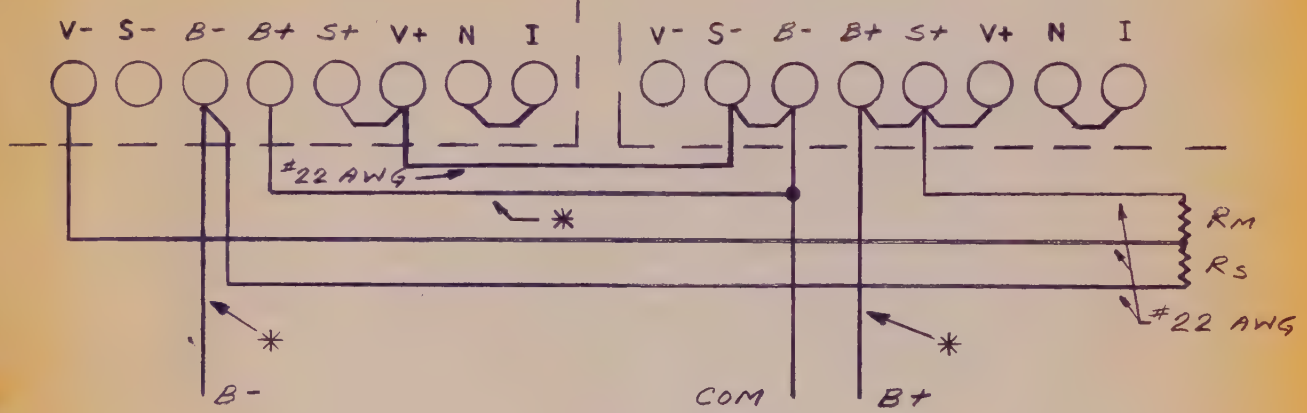
SLAVE POWER SUPPLY

NOTE: SLAVE POWER SUPPLY CONTROLS DO NOT EFFECT OUTPUT.

MASTER POWER SUPPLY

NOTE: MASTER POWER SUPPLY USE VOLTAGE AND CURRENT CONTROLS IN CONVENTIONAL MANNER.



CONNECTION DIAGRAM FOR PLACING TWO MODEL SP POWER SUPPLIES IN SERIES.

SELECT R_M & R_S FOR OUTPUT VOLTAGE DESIRED

R_M = 10X (OUTPUT VOLTAGE OF MASTER UNIT) IN OHMS.

R_S = 10X (OUTPUT VOLTAGE OF SLAVE UNIT) IN OHMS.

DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING.

ALL EXTERNAL THREADS TO BE CLASS 2A (AMER STD); ALL INTERNAL THREADS TO BE CLASS 2B (AMER STD). UNLESS OTHERWISE SPECIFIED

VAR

BA DIMEN

UP T

ABOVE 6

ABOV

AN

SEE

SCALE:

B-12789

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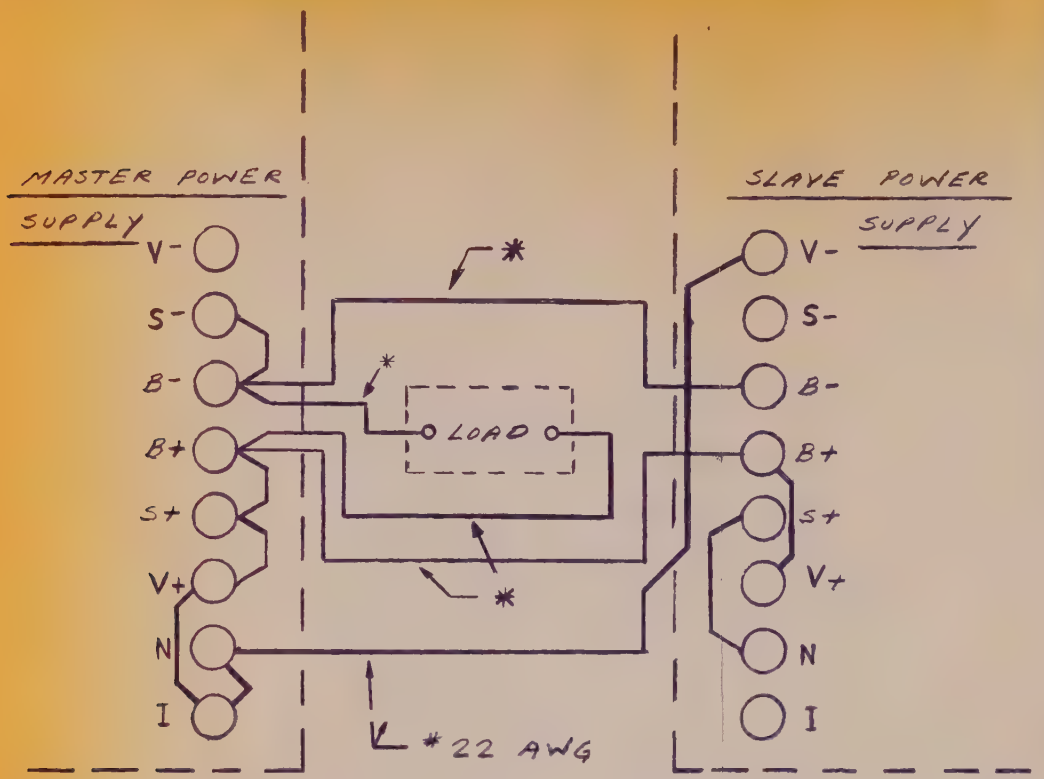
COPYMATION INC., PHILA.

REVISIONS	
AP. BY AP. MFG.	0
ECN 73-5 R. C. K. (REDRAWN) 2-15-73.	1
ECN 73-89 R.D.P. (REDRAWN) 11-14-73 JPL	2



NOTE: MASTER POWER SUPPLY USE VOLTAGE & CURRENT CONTROLS IN CONVENTIONAL MANNER.

NOTE: SLAVE POWER SUPPLY CONTROLS DO NOT EFFECT OUTPUT.

CONNECTION DIAGRAM FOR PARALLELING TWO MODEL SP POWER SUPPLIES.

*- WIRE GAUGE TO CARRY MAXIMUM CURRENT RATING OF UNIT.

IONS ON FINISHED DIMENSIONS UNLESS OTHERWISE MARKED		
ONS	FRACTIONAL DIMENSIONS	DECIMAL DIMENSIONS
6	± 1/64	± .005
0 24	± 1/32	± .010
24	± 1/16	± .015
ULAR DIMENSIONS		± 1/2-
RCH. SPEC. FOR STOCK TOLERANCES		

CONNECTION DIAGRAMS FOR PLACING TWO UNITS IN SERIES OR PARALLEL MASTER SLAVE OPERATION

FIRST MADE FOR

USED ON

BEGUN BY

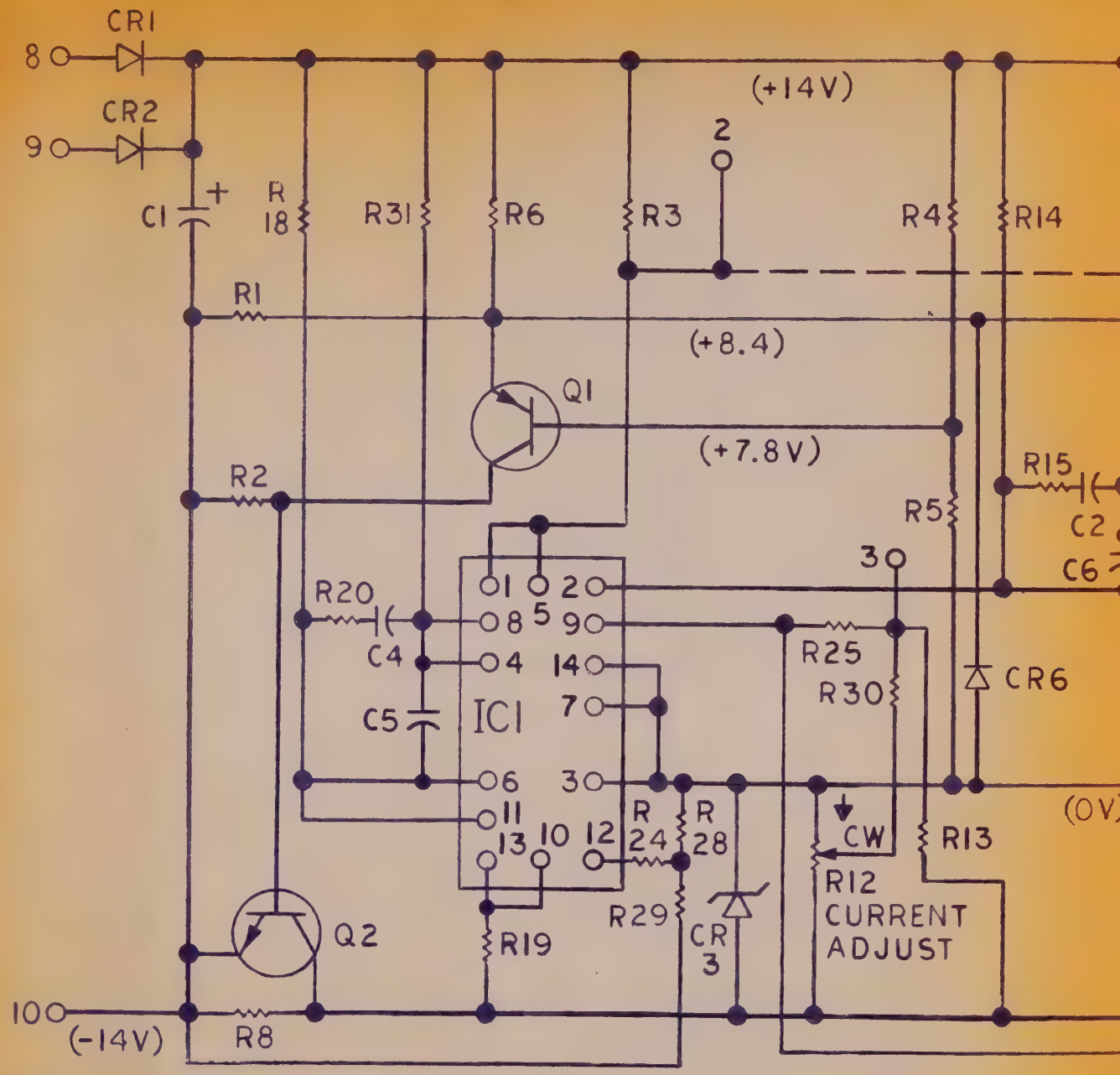
FINISHED BY R. C. KLINGER 2-15-73

TRACED BY

CHECKED BY

Deltron inc. PHILA. 33, PA.

B 12789



NOTE: FOR VALUES OF COMPONENTS
SEE LIST OF PARTS.

DOTTED COMPONENTS USED ON SP60 & SP100 ONLY.

MENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING.
L EXTERNAL THREADS TO BE CLASS 2A (AMER STD) ALL INTERNAL THREADS TO BE CLASS 2B (AMER STD) UNLESS OTHERWISE SPECIFIED

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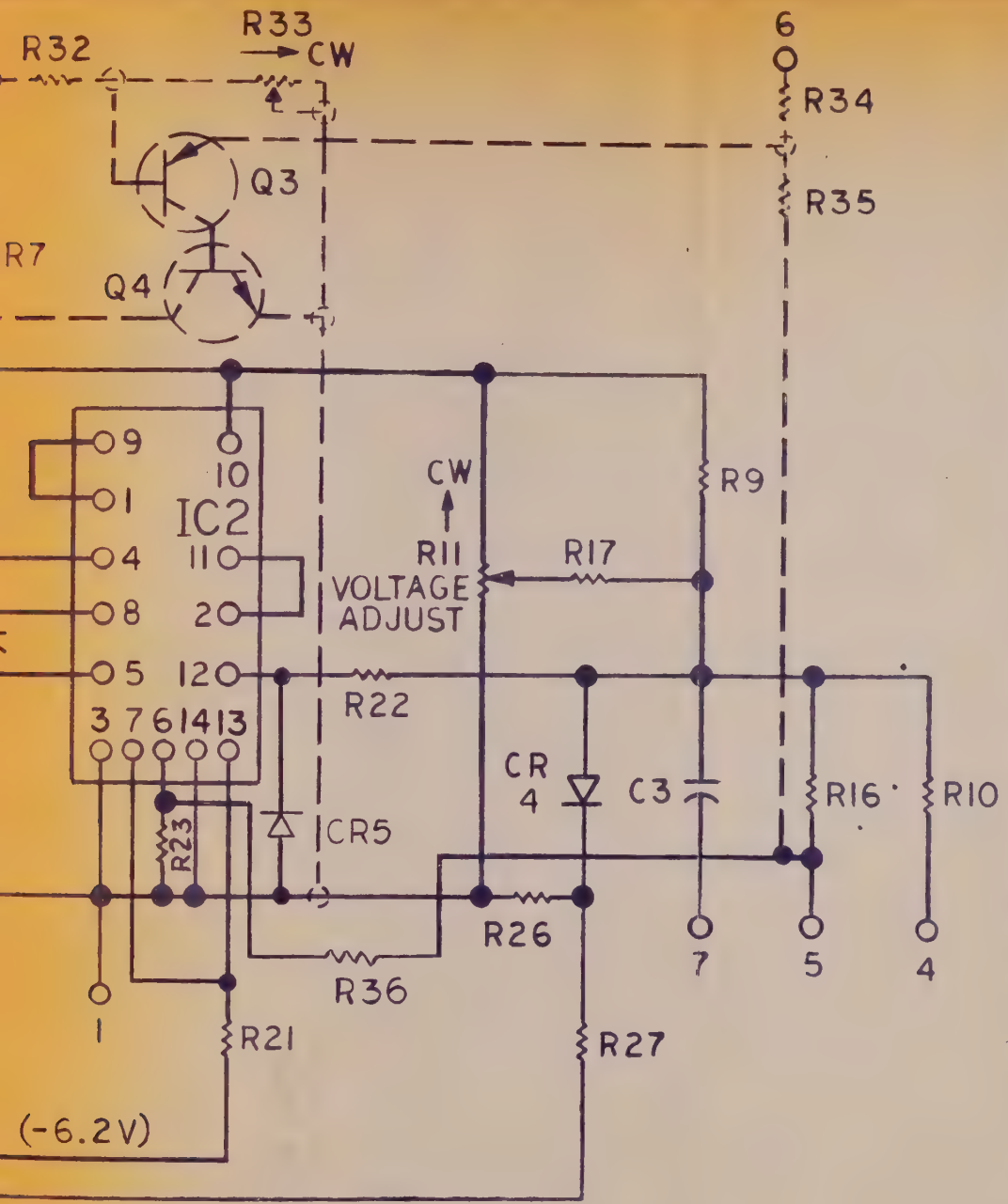
... AND ... MAY NOT BE REPRODUCED OR COPIED, OR USED AS THE
BASIS OF DEVICES WITHOUT THE WRI
...RST OBTAINED.

SCALE:

B-13540



ECN 69-168 H/LINSKI 8/21/69	1
ECN 69-178 H/LINSKI 9/26/69	2
ECN 71-79 R.C. KLINGER 8-12-71	3

SCHEMATIC

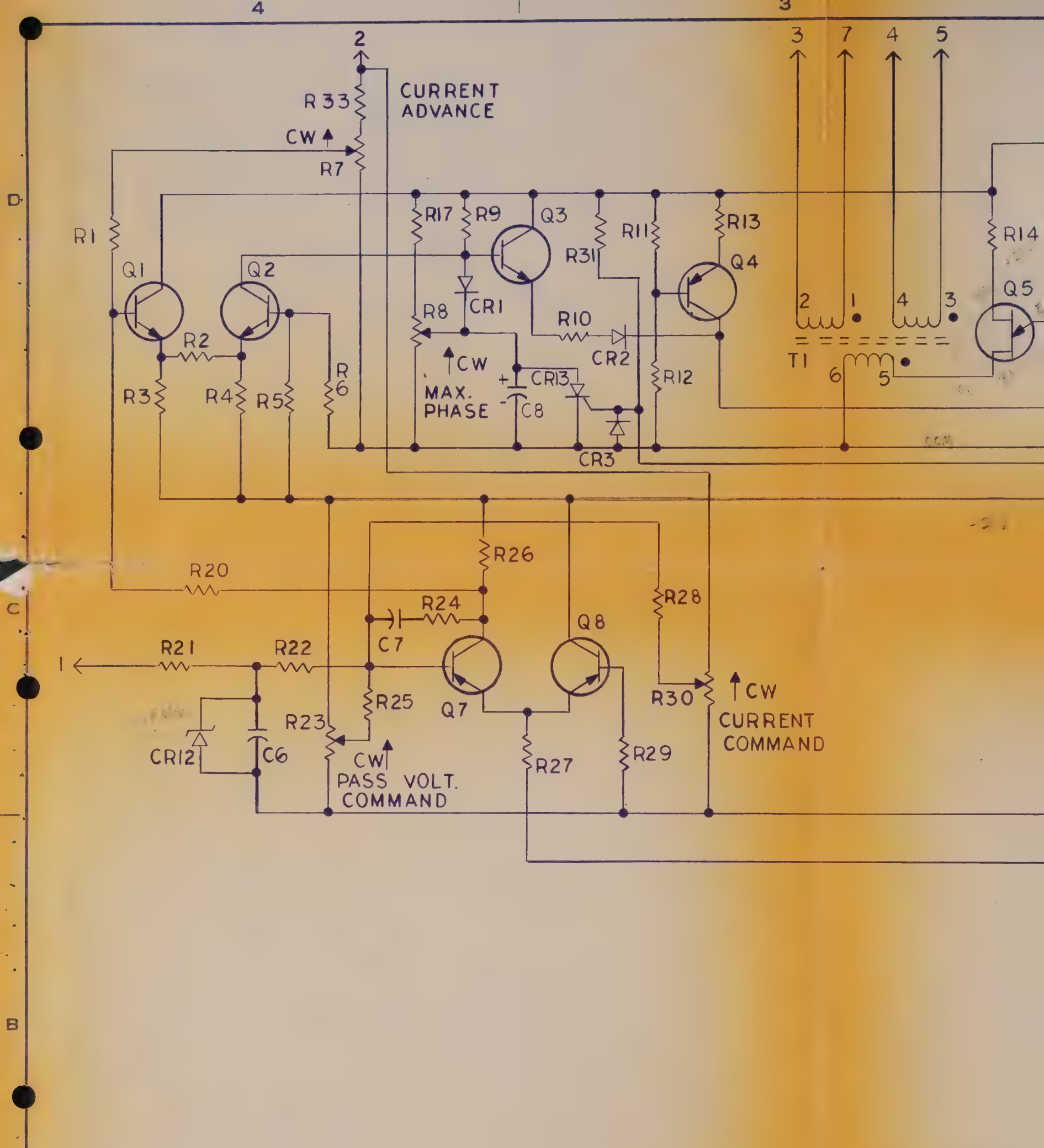
FIRST MADE FOR "K" AMPLIFIER

BEGUN BY

FINISHED BY R.C. KLINGER 4/17/69

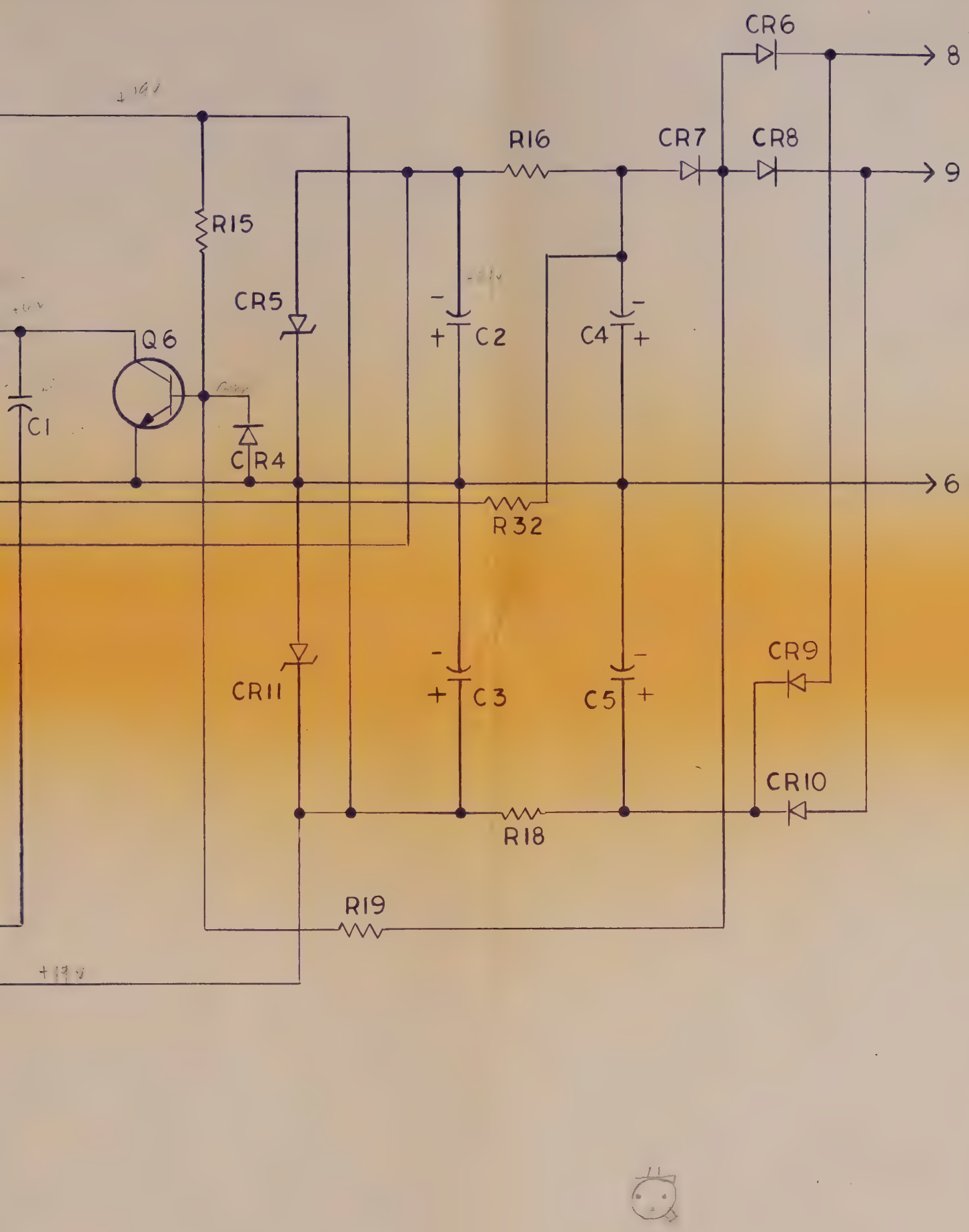
Deltron inc
PHILA PA

B 13540



NOTE:

1. FOR VALUES OF COMPONENTS SEE LIST OF PARTS.
2. COMPONENTS NOT ON THE PARTS LIST ARE NOT USED ON THAT PARTICULAR UNIT. THIS RULE IS VALID FOR COMPONENTS SHOWN SOLID AS WELL AS DOTTED.



REVISIONS	
AP. BY / AP. MFG.	0
ECN 67-22 STEINER 2-10-67	1
ECN 73-25 R. C. K. 4-5-73	2

C12744

DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING.
ALL EXTERNAL THREADS TO BE CLASS 2A (AMER STD); ALL INTERNAL THREADS TO BE CLASS 2B (AMER STD). UNLESS OTHERWISE SPECIFIED.

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SCALE: —

VARIATIONS ON FINISHED DIMENSIONS UNLESS OTHERWISE MARKED

BASIC DIMENSIONS	FRACTIONAL DIMENSIONS	DECIMAL DIMENSIONS
UP TO 6	± 1/64	± .005
ABOVE 6 TO 24	± 1/32	± .010
ABOVE 24	± 1/16	± .015
ANGULAR DIMENSIONS		± 1/2°

SEE PURCH. SPEC. FOR STOCK TOLERANCES

SCHEMATIC
PRE REGULATOR BOARD FOR S.P.

FIRST MADE FOR SP — USED ON

BEGUN BY — TRACED BY

FINISHED BY STEINER 6-22-66 — CHECKED BY Stepansky 6/30/66

Deltron inc. PHILA. 33, PA.

C 12744

3. Calculate 10% of the power supply nominal output voltage and add one half volt.
4. Energize power supply, monitor its output voltage, and set the output voltage to nominal (see "Controls" in Power Supply Instructions).
5. While observing power supply voltage, slowly rotate the adjustment on crowbar counterclockwise until crowbar firing is evidenced by a sharp reduction in the power supply output. Hold this setting. Denergize power supply to reset crowbar.
6. Divide the 10% + 0.5 volt figure calculated in (3) by 2.8 volts per turn, the constant of the crowbar voltage adjustment. This quotient will be a number (or fraction) of turns.
7. Turn the crowbar firing point adjustment clockwise the number of turns (or fraction) calculated in (6) from the setting held in (5).
8. The crowbar is now correctly set.

Example: When crowbar is used with a 24 volt Series "N" Unit

$$24 \times 10\% + 0.5 = 2.4 + 0.5 = 2.9 \text{ Volts}$$

$$\frac{2.9 \text{ Volts}}{2.8 \text{ Volts/Turn}} = 1.0 \text{ Turn}$$

Increase crowbar setting 1 turn clockwise from the 24 volt setting obtained in step (5).

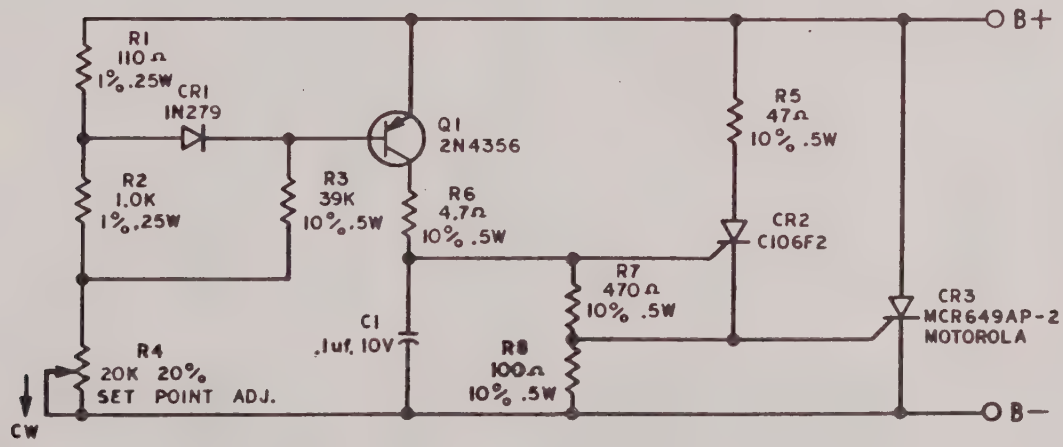
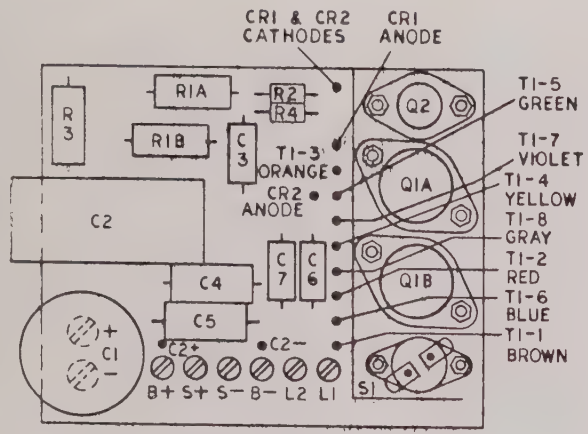
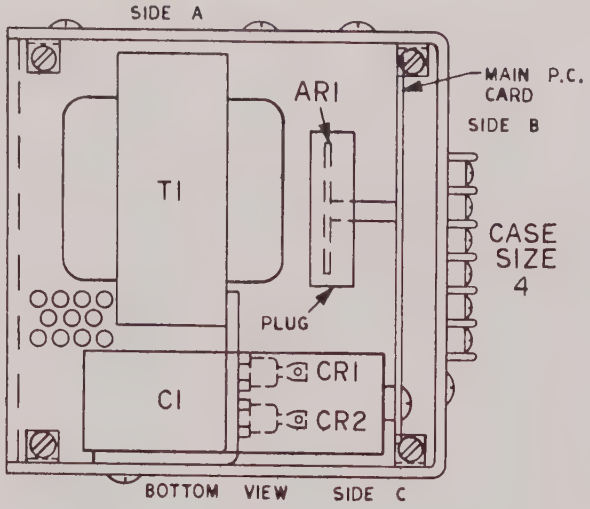


FIGURE 1: SCHEMATIC DIAGRAM CB1



MAIN PRINTED CIRCUIT CARD

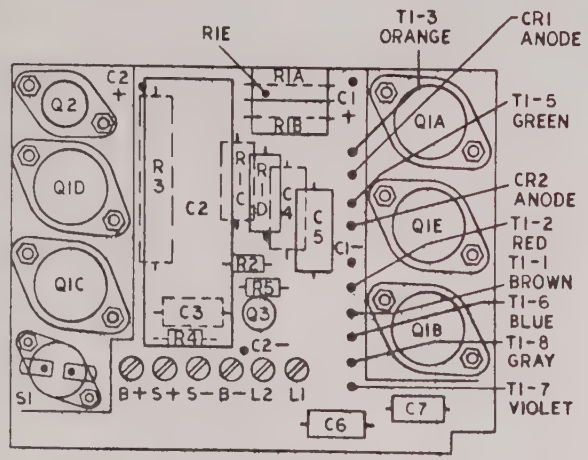


DISASSEMBLY INSTRUCTIONS

A. COVER REMOVAL:
1. REMOVE ALL SCREWS HOLDING PERFORATED COVER/ AND CAREFULLY SLIDE IT OFF.

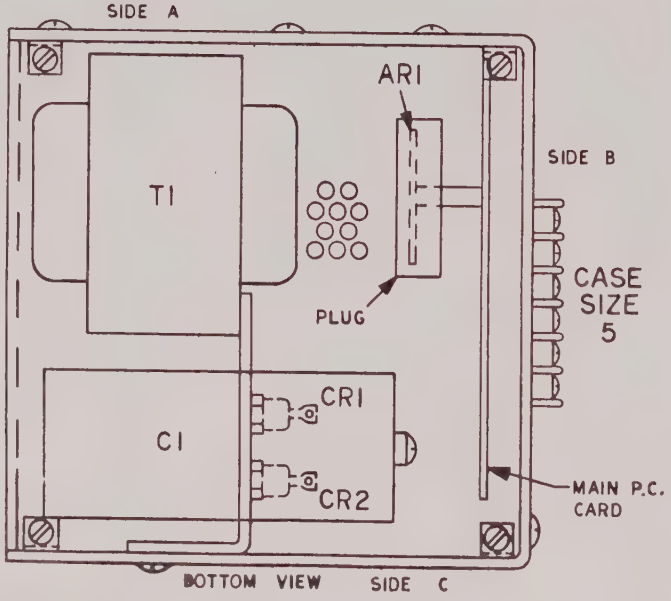
B. AMPLIFIER ARI REMOVAL:
1. CAREFULLY REMOVE PLUG FROM AMPLIFIER.
2. REMOVE SCREW TO AMPLIFIER ASSEMBLY VISIBLE THRU HOLE IN SIDE B. (SPACER REMAINS WITH AMPLIFIER.)
3. FROM INSIDE OF UNIT REMOVE REMAINING SCREW HOLDING AMPLIFIER. THIS SPACER TO STAY WITH MAIN P.C. CARD.

C. ELECTRONIC ASSEMBLY REMOVAL:
1. REMOVE ALL SCREWS FROM SIDE A, SIDE B AND SIDE C.
2. CAREFULLY SLIDE COVER OFF ASSEMBLY.



MAIN PRINTED CIRCUIT CARD

NOTE: DOTTED COMPONENTS ON OTHERSIDE.



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C. ELECTRONIC ASSEMBLY REMOVAL:
1. REMOVE ALL SCREWS FROM SIDE A, SIDE B AND SIDE C.
2. CAREFULLY SLIDE COVER OFF ASSEMBLY.

loss of regulation and an increase of ripple in the output. To remedy this fault, the shorted transistor should be replaced with an equivalent type.

A shorted transistor may usually be located with the use of an ohmmeter on the low ohms range. A shorted driver transistor, Q2 (or Q3), or a faulty error amplifier, AR-1, can also produce a high unregulated output. If there is input voltage across C1, but there is no output, it is likely that the pass transistor(s), Q1, or one of the drivers, Q2 (or Q3), is open circuited. A defective error amplifier AR1, or an overvoltage crowbar accessory that has triggered can also produce a very low output voltage.

If the input fuse fails whenever AC power is applied, one of the input rectifiers, CR1 or CR2 or an input capacitor, C1, is probably short circuited. These failures may be detected with an ohmmeter also. It should be noted that fuses, especially in the smaller ratings, may fail due to mechanical or thermal fatigue even though no fault has occurred.

Due to the nature of integrated circuits and the necessary close proximity of conductors on the printed circuit board, it is recommended that field repairs to the error amplifier not be attempted. If there is no output from the power supply and connector point 2 at the error amplifier connector is not positive with respect to connector point 1; if there is high, unregulated output from the power supply and connector point 2 is a volt or two positive with respect to connector point 1 (base of first darlington driver positive with respect to S+); or if the bias voltages in the error amplifier do not correspond to those on Page 12, it is recommended that the error amplifier be replaced with one known to be operable. If the 28 volt input voltage across C1 (error amplifier) is not present, check C1, CR1 or CR2 on the AR1 printed circuit board for short circuits.

When a malfunction occurs, it may cause subsequent damage to other components in the supply, so it is good practice to check these as well. A visual inspection is also recommended to detect burned out parts. On a routine basis, it is sufficient to keep the unit clean and free from obstructions.

SERVICE

For repair service or special operating instructions, contact the factory where complete facilities and trained personnel are available for your assistance. Please furnish power supply model and serial numbers along with a detailed description of the problem encountered in any correspondence with the factory. Repairs not covered by warranty will be billed at cost. An estimate will be forwarded for approval on request.

REPLACEMENT PARTS

Special and standard components used in all Deltron equipment may be obtained from the factory. When ordering these parts, the following information is required: (1) Model and Serial No. of Power Supply, (2) Date purchased, (3) Deltron Part No. or Manufacturer and Part No., (4) Parts list sheet, item and group no. or circuit designation and drawing no., and (5) Complete description, designation, and location of the part in the supply, if the part is not listed on parts list or drawing.

SPECIFICATIONS

LINE REGULATION Input change from minimum to maximum	0.005% + 500 μv
LOAD REGULATION Load change from zero to maximum	0.005% + 500 μv
RMS RIPPLE AND NOISE 60 Hz input, one terminal grounded, broad band	500 μv
TEMPERATURE COEFFICIENT Average over rated temperature range	0.02% + 500 μv/°C
ISOLATION	300 volts DC
INPUT VOLTAGE	105-125 volts 45-440 Hz. Current ratings are for 55-65 Hz. Delete 40°C ratings for operation at 45-55 Hz. Contact factory for ratings and specifications for operation at any other frequency.
OPERATING TEMPERATURE	71°C maximum. Multiply current by factor shown for ambient temperatures above 40°C.

Nominal Voltage	50°C	60°C	71°C
3 - 6	.9	.7	.5
9 - 12	.9	.75	.6
Over 12	.9	.8	.7

STORAGE TEMPERATURE	-25°C to 85°C
OVERLOAD AND SHORT CIRCUIT	Adjustable cutback current limiting with automatic recovery after overload is removed protects the supply and external load.
THERMAL OVERLOAD	Thermal cutout with automatic recovery when temperature returns to normal.
REMOTE PROGRAMMING CONSTANTS	Resistance - Nominally 1000 ohms per volt in excess on minimum rated output voltage. Voltage - Volt per volt in excess of minimum rated output voltage.
CONTROLS	22 turn infinite resolution screwdriver voltage adjustment. 22 turn infinite resolution screwdriver current limit adjustment.

TERMINALS

Heavy duty screw terminal block. See Page 2 for terminal designations. Line voltage is connected to terminals marked L1 and L2, positive output is connected to B+; negative output to B-. Local Sensing - Links supplied connecting B+ to S+ and B- to S-. Remote Sensing and Remote Programming - See Operation, Page 5.

WEIGHTS AND RECOMMENDED INPUT FUSE SIZES

Case Size	Weight, Pounds	Input Fuse Rating (Bussman Type ABC or Littlefuse Type 3AB)
1	2-1/4	1/2 Ampere
2	3-3/4	3/4 Ampere
3	5-3/4	2 Ampere
4	8-1/2	3 Ampere
5	13-1/2	5 Ampere
6	19	8 Ampere
7	22-1/2	12 Ampere
8	34	20 Ampere

DESCRIPTION

Series "N" Power Supplies are solid state modular DC power sources. All silicon semiconductors are used for operation up to 71°C. Integrated circuits are included in the strategic portions of the error amplifier to enhance thermal and electrical stability. "N" Units incorporate self-cooling so that external heat sinking or forced air is unnecessary.

Plug-in, modular and printed circuit construction is utilized where possible to minimize wiring and permit a clean, uncluttered construction. The unit is completely enclosed with no exposed semiconductors or other active electrical components.

ACCESSORIES

Fully wired accessory control panels, blank filler panels and rack adapters are available for assembling custom power supply systems.

A two terminal overvoltage crowbar is also available. It is designed for rapid external mounting on any "N" Unit.

MOUNTING

See Page 2 for dimensions. The unit may be mounted in any plane. There are mounting holes with tapped inserts on three adjacent sides. If the unit is operated with a perforated side horizontal and adjacent to the mounting surface, precautions must

be taken not to impede the natural flow of air through the unit. When possible, use the hardware supplied with the four spacers between the unit and the mounting surface. If other screws must be used because of the thickness of the mounting surface, be certain that the ends of the mounting screws do not contact components within the unit and that spacers are used. If the side of the power supply containing the terminal block is used for mounting, the appropriate cut out size shown on Page 2 may be used on the mounting surface to clear the terminal block.

To mount, four clearance holes for the mounting screws as shown in the Mtg. Hole Size Table on Page 2 are made in the mounting surface on the centers shown on the Drawing. The four mounting screws supplied with the unit are inserted through the holes, the supplied spacers are slid over the screws and the screws are inserted into the appropriate four tapped inserts in the unit and tightened. Note: The mounting hole center dimensions on the three sides are not identical.

OPERATION

MODE

Constant voltage source with adjustable cutback current limiting. Load current must not exceed values shown in derating Table on Page 1. When load current exceeds 105% of the 40°C value, the output current and voltage both decrease until at zero voltage (short circuit), the current is approximately 20% of the rated current.

CONNECTIONS:

INPUT

The AC power line is connected to terminals 1 and 2. A fuse of the size and type recommended in the Table on Page 4 must be placed in the "hot" AC lead. Caution: Do not apply AC power unless the sensing leads are connected.

SENSING AND LOAD

The unit is shipped from the factory with a link between B+ and S+ and another between B- and S- for local sensing. The load is connected between B+ and B-. See Figure 1.

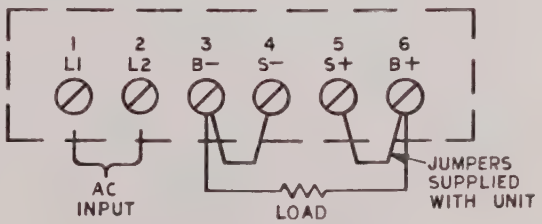


FIGURE 1: LOCAL SENSING

The resistance of the leads between the power supply and the load may allow excessive regulation at the load. To correct for the drop in the load leads, remote sensing may be used. See Figure 2.

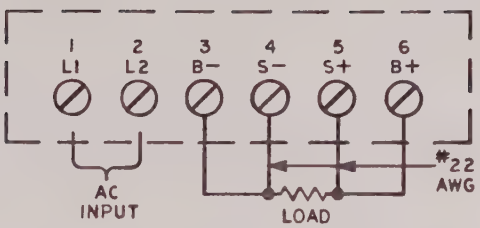


FIGURE 2: REMOTE SENSING

The links between B+ to S+ and B- to S- are disconnected. Two 22 AWG wires are connected--one between S+ and the positive side of the load and the other between S- and the negative side of the load. The load still remains connected between B+ and B-. Note: The load leads must be sized so the total voltage drop across both leads does not exceed the 5% output voltage band width at rated lead current.

When remote sensing, the current limit control may require readjustment in order to obtain full rated current. See Controls, Page 9.

Note: All specifications are measured at the terminal block with local sensing.

RESISTANCE PROGRAMMING

A resistor of value given under Remote Programming Constants, Page 3, is placed between S- and B- (with link removed) if sensing is local or between S- and the negative side of the load in the case of remote sensing. See Figure 3.

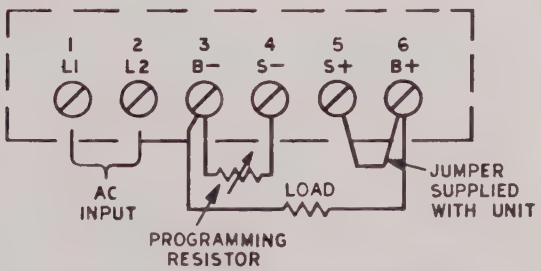


FIGURE 3: RESISTANCE PROGRAMMING

The resistor used must be capable of carrying a maximum of 2 milliamperes and have a low thermal coefficient of resistance for stable operation. The internal voltage control (see Controls, Page 9) should be set for minimum output voltage (counterclockwise).

VOLTAGE PROGRAMMING

A variable voltage source capable of sinking 2 milliamperes and being varied through the regulating range (±5% of rated output voltage) is connected positive terminal to S- and negative to B- or to the negative side of the load. The internal voltage control should be set for minimum rated output. The power supply output voltage will then equal the sum of the minimum rated voltage and the programming voltage. See Figure 4.

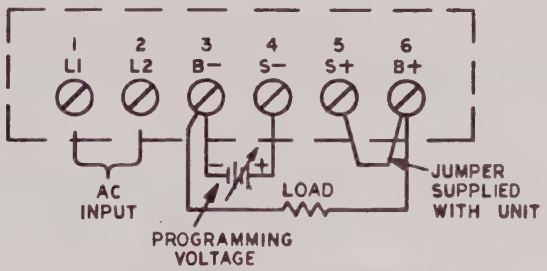


FIGURE 4: VOLTAGE PROGRAMMING

SERIES OPERATION

Like "N" Units may be operated in series up to a total of 300 volts. A silicon rectifier capable of carrying the rated output current must be connected across the output of each such unit: anode to B- and cathode to B+. See Figure 5.

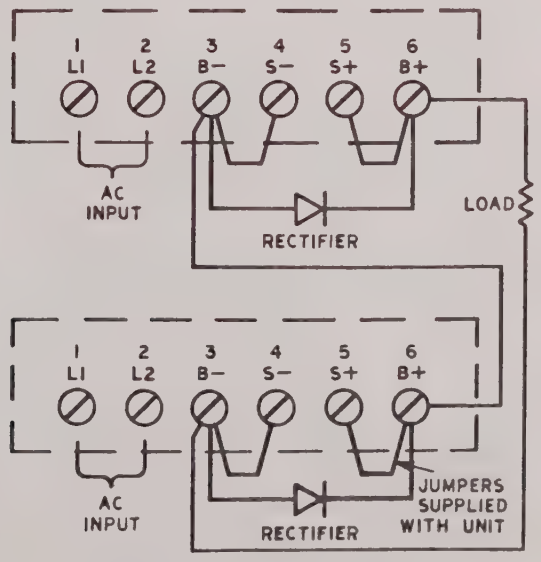


FIGURE 5: SERIES OPERATION

It is also recommended that AC power be applied to all the units connected in series before the load is applied.

PARALLEL OPERATION

Two Series "N" Units with identical model numbers may be operated in parallel. The input terminals L1 of both supplies must be paralleled and likewise the L2 terminals must be paralleled. See Figure 6.

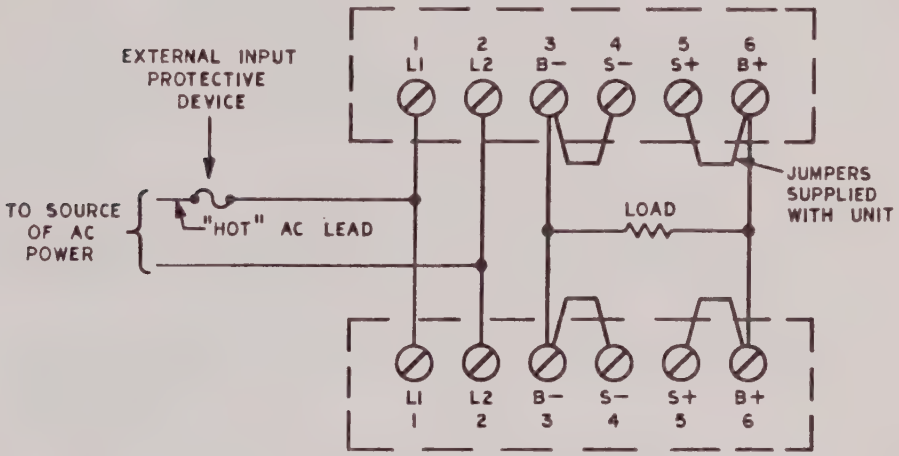


FIGURE 6: PARALLEL OPERATION

The input protective device must be sized to carry the input current for both paralleled units.

TERMINAL DESIGNATION

1	AC Input	(L1)
2	AC Input	(L2)
3	Negative Output	(B-)
4	Negative Sensing	(S-)
5	Positive Sensing	(S+)
6	Positive Output	(B+)

OVERLOAD

When the 40°C current rating is exceeded, the unit goes into cutback operation causing lowered output voltage and current. The unit will reset immediately to the correct output voltage upon removal of the overload.

When the unit is operated at an output current which exceeds the current rating for the operating ambient temperature, causing overheating, a thermostat actuates to cut off output current. The thermostat will reset automatically following the removal of the overload and the subsequent cooling of the supply. Do not operate the supply at an output current exceeding the specified maximum for the corresponding operating ambient temperatures.

INSTRUCTIONS

FOR

CROWBAR MODEL CB1

DESCRIPTION

The Model CB1 Crowbar prevents damage to loads connected to a Deltron Series "N" Power Supply from overvoltage arising from internal or external conditions. It short circuits the output of the power supply within a few microseconds after the voltage reaches the preset threshold.

Model CB1 is designed to mount quickly and easily to the side of "N" Units. Since the crowbar requires heat sinking equivalent to that of the "N" Module, it is recommended that it not be employed in other applications without explicit instruction from the factory.

The crowbar will not provide overvoltage protection for loads capable of supplying extremely high currents such as storage batteries when such devices are used in conjunction with Series "N" Supplies.

The range of adjustment is approximately 4 to 60 volts, so the one model is used with all Series "N" Units.

THEORY OF OPERATION

Refer to schematic diagram, Figure 1. R1, R2, and R4 form a voltage divider for the power supply voltage, B+ to B-. When the power supply voltage increases so that the portion across R1 exceeds the threshold voltage of Q1 base-emitter, Q1 conducts, firing silicon controlled rectifier, CR1, through R6. CR1 supplies gate current to SCR CR3 causing it to fire and effectively short circuit the power supply output. The power supply will maintain holding current through CR3, so it will be necessary to turn off the power supply to reset the crowbar.

INSTALLATION

1. Place the crowbar on the side of the power supply near the terminal block. Be certain the edge of the CB1 from which the leads emerge faces the terminal block.
2. Align the screws supplied with the crowbar to the matching tapped holes in the side of the "N" Unit and thoroughly tighten both screws.
3. Connect the lug of the red lead under the B+ (Terminal 6) screw on the terminal block and the blue lead under the B- (Terminal 3) screw.

ADJUSTMENT

1. Turn screw driver adjustment on top of crowbar fully clockwise.

2. The recommended minimum firing point of the crowbar is 10% plus 0.5 volt above the nominal voltage of the power supply.

TABLES OF

MODELS AND RATINGS

Note: See Page 2 for dimensions and locations of mounting holes. External surfaces are black anodized aluminum.

CASE SIZE 1 3¼L x 3¼W x 4¾H
WT. 2¼LB.

MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-0.80	3 ± 5%	0.80
N5-0.76	5 ± 5%	0.76
N6-0.74	6 ± 5%	0.74
N9-0.53	9 ± 5%	0.53
N12-0.53	12 ± 5%	0.53
N15-0.42	15 ± 5%	0.42
N18-0.39	18 ± 5%	0.39
N21-0.35	21 ± 5%	0.35
N24-0.34	24 ± 5%	0.34
N28-0.34	28 ± 5%	0.34
N32-0.22	32 ± 5%	0.22
N36-0.21	36 ± 5%	0.21
N40-0.21	40 ± 5%	0.21
N48-0.21	48 ± 5%	0.21

CASE SIZE 2 4L x 4W x 4¾H
WT. 3¾LB.

MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-1.5	3 ± 5%	1.5
N5-1.45	5 ± 5%	1.45
N6-1.4	6 ± 5%	1.4
N9-1.2	9 ± 5%	1.2
N12-1.0	12 ± 5%	1.0
N15-0.75	15 ± 5%	0.75
N18-0.69	18 ± 5%	0.69
N21-0.60	21 ± 5%	0.60
N24-0.53	24 ± 5%	0.53
N28-0.53	28 ± 5%	0.53
N32-0.51	32 ± 5%	0.51
N36-0.44	36 ± 5%	0.44
N40-0.37	40 ± 5%	0.37
N48-0.35	48 ± 5%	0.35

CASE SIZE 3 5L x 5W x 4¾H
WT. 5¾LB.

MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-3.8	3 ± 5%	3.8
N5-3.7	5 ± 5%	3.7
N6-3.5	6 ± 5%	3.5
N9-3.0	9 ± 5%	3.0
N12-2.8	12 ± 5%	2.8
N15-2.7	15 ± 5%	2.7
N18-2.6	18 ± 5%	2.6
N21-2.2	21 ± 5%	2.2
N24-2.0	24 ± 5%	2.0
N28-1.9	28 ± 5%	1.9
N32-1.2	32 ± 5%	1.2
N36-1.1	36 ± 5%	1.1
N40-1.1	40 ± 5%	1.1
N48-1.0	48 ± 5%	1.0

CASE SIZE 4 6L x 6W x 4¾H
WT. 8½LB.

MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-5.3	3 ± 5%	5.3
N5-5.2	5 ± 5%	5.2
N6-5.2	6 ± 5%	5.2
N9-4.4	9 ± 5%	4.4
N12-4.0	12 ± 5%	4.0
N15-3.5	15 ± 5%	3.5
N18-3.2	18 ± 5%	3.2
N21-2.9	21 ± 5%	2.9
N24-2.7	24 ± 5%	2.7
N28-2.5	28 ± 5%	2.5
N32-2.2	32 ± 5%	2.2
N36-2.0	36 ± 5%	2.0
N40-1.8	40 ± 5%	1.8
N48-1.7	48 ± 5%	1.7

CASE SIZE 5 7L x 7W x 4¾H
WT. 13½LB.

MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-11	3 ± 5%	11.
N5-10.5	5 ± 5%	10.5
N6-9	6 ± 5%	9
N9-8	9 ± 5%	8
N12-7.3	12 ± 5%	7.3
N15-6.3	15 ± 5%	6.3
N18-5.8	18 ± 5%	5.8
N21-4.7	21 ± 5%	4.7
N24-4.6	24 ± 5%	4.6
N28-4.6	28 ± 5%	4.6
N32-3.9	32 ± 5%	3.9
N36-3.6	36 ± 5%	3.6
N40-3.3	40 ± 5%	3.3
N48-3.0	48 ± 5%	3.0

CASE SIZE 6 7L x 7W x 8¼H
WT. 19 LB.

MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-20	3 ± 5%	20
N5-19	5 ± 5%	19
N6-18	6 ± 5%	18
N9-15	9 ± 5%	15
N12-15	12 ± 5%	15
N15-13	15 ± 5%	13
N18-12	18 ± 5%	12
N21-11	21 ± 5%	11
N24-9.2	24 ± 5%	9.2
N28-9.2	28 ± 5%	9.2
N32-8.7	32 ± 5%	8.7
N36-7.3	36 ± 5%	7.3
N40-6.2	40 ± 5%	6.2
N48-6.1	48 ± 5%	6.1

CASE SIZE 7 7¾L x 7¾W x 8¼H
WT. 22½LB.

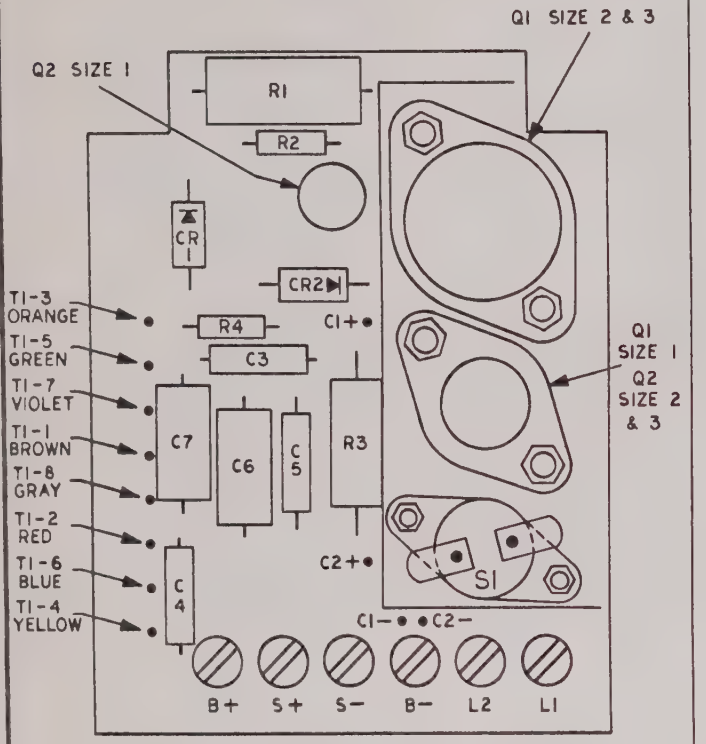
MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-24	3 ± 5%	24
N5-23	5 ± 5%	23
N6-22	6 ± 5%	22
N9-20	9 ± 5%	20
N12-17	12 ± 5%	17
N15-17	15 ± 5%	17
N18-16	18 ± 5%	16
N21-14	21 ± 5%	14
N24-13	24 ± 5%	13
N28-12	28 ± 5%	12
N32-11	32 ± 5%	11
N36-10	36 ± 5%	10
N40-9	40 ± 5%	9
N48-8.5	48 ± 5%	8.5

CASE SIZE 8 9L x9W x 8¼ H
WT. 34 LB.

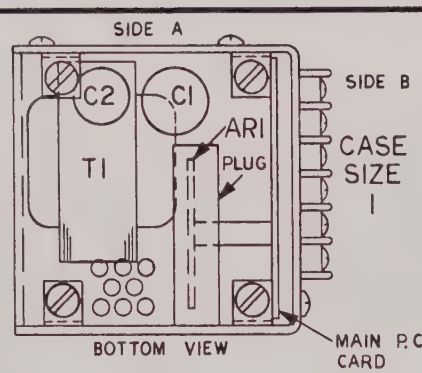
MODEL	VOLTAGE RANGE	MAX. AMPS AT 40°C
N3-36	3 ± 5%	36
N5-35	5 ± 5%	35
N6-34	6 ± 5%	34
N9-32	9 ± 5%	32
N12-28	12 ± 5%	28
N15-28	15 ± 5%	28
N18-25	18 ± 5%	25
N21-22	21 ± 5%	22
N24-20	24 ± 5%	20
N28-19	28 ± 5%	19
N32-18	32 ± 5%	18
N36-17	36 ± 5%	17
N40-15	40 ± 5%	15
N48-12	48 ± 5%	12

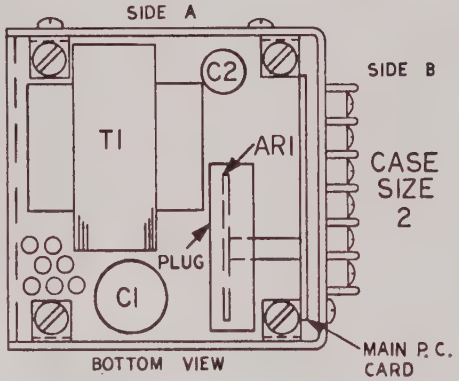
MODEL	CASE SIZE	C1 uf.-V	QTY.	C2 uf.-V	C3 C6 C7	C4 C5	CR1-CR2	Q1	QTY.	Q2	Q3	R1 5W	QTY.	R2 10%, ½W	R3	QTY.	R4	R5	S1	T1
N3-20	6	46000-15	1	10000-5	0.01UF.-400V	0.1UF.-200V	A40A 100V G.E.	2N3055	7	2N3055	40250 RCA	0.33Ω	7	5.6Ω	15Ω,5W	1	15Ω,10%,1/2W	47Ω,10%,1/2W	STEMCO TYPE A510 CLOSE ON RISE AT 284°F OPEN AT 255°F	T60192-1
N5-19	6	35000-20	1	7000-10			A40A 100V G.E.	2N3055	7	2N3055		0.33Ω	7	5.6Ω	50Ω,5W	1				T60192-30
N6-18	6	35000-20	1	7000-10			A40A 100V G.E.	2N3055	6	2N3055		0.25Ω	6	6.8Ω	15Ω,5W	1				T60192-2
N9-15	6	35000-20	1	5000-15			A40A 100V G.E.	2N3055	5	2N3055		0.25Ω	5	6.8Ω	50Ω,5W	1				T60192-3
N12-15	6	29000-25	1	5000-15			A40A 100V G.E.	2N3055	6	2N3055		0.33Ω	6	6.8Ω	75Ω,5W	1				T60192-4
N15-13	6	23500-35	1	2250-20			A40A 100V G.E.	2N3055	6	2N3055		0.4Ω	6	6.8Ω	75Ω,5W	1				T60192-5
N18-12	6	23500-35	1	2250-20			A40A 100V G.E.	2N3055	5	2N3055		0.33Ω	5	6.8Ω	125Ω,5W	1				T60192-6
N21-11	6	23500-35	1	1500-25			A40A 100V G.E.	2N3055	4	2N3055		0.33Ω	4	8.2Ω	150Ω,5W	1				T60192-7
N24-9.2	6	15000-50	1	1400-35			A40A 100V G.E.	2N3055	4	2N3055		0.33Ω	4	8.2Ω	400Ω,5W	2				T60192-8
N28-9.2	6	15000-50	1	1400-35			A40A 100V G.E.	2N3055	5	2N3055		0.4Ω	5	6.8Ω	400Ω,5W	2				T60192-9
N32-8.7	6	7750-75	1	1400-35			A40A 100V G.E.	2N3055	6	2N3055	40313 RCA	0.67Ω	6	6.8Ω	400Ω,5W	2				T60192-10
N36-7.3	6	7750-75	1	750-50			367D 200V WEST.	37792A	4	37792A		0.5Ω	4	8.2Ω	600Ω,5W	2				T60192-11
N40-6.2	6	7750-75	1	750-50			367D 200V WEST.	37792A	4	37792A		0.5Ω	4	8.2Ω	600Ω,5W	2				T60192-12
N48-6.1	6	7750-75	1	500-75			367D 200V WEST.	37792A	5	37792A		0.67Ω	5	6.8Ω	700Ω,5W	2				T60192-13
N3-24	7	33000-15	2	15000-5			IN2128A IRC	2N3055	8	2N3055	40250 RCA	0.25Ω	8	5.6Ω	15Ω,5W	1				T60193-1
N5-23	7	25000-20	2	10000-10			IN2128A IRC	2N3055	8	2N3055		0.33Ω	8	5.6Ω	15Ω,5W	1				T60193-30
N6-22	7	25000-20	2	10000-10			IN2128A IRC	2N3055	8	2N3055		0.33Ω	8	5.6Ω	15Ω,5W	1				T60193-2
N9-20	7	20000-25	2	8000-15			IN2128A IRC	2N3055	8	2N3055		0.33Ω	8	5.6Ω	30Ω,10W	1				T60193-3
N12-17	7	15000-35	2	8000-15			A40A 100V G.E.	2N3055	9	2N3055		0.5Ω	9	5.6Ω	30Ω,10W	1				T60193-4
N15-17	7	15000-35	2	6500-20			A40A 100V G.E.	2N3055	9	2N3055		0.5Ω	9	5.6Ω	50Ω,10W	1				T60193-5
N18-16	7	15000-35	2	6500-20			A40A 100V G.E.	2N3055	8	2N3055		0.4Ω	8	5.6Ω	50Ω,10W	1				T60193-6
N21-14	7	10000-50	2	5000-25			A40A 100V G.E.	2N3055	8	2N3055		0.5Ω	8	5.6Ω	100Ω,10W	1				T60193-7
N24-13	7	10000-50	2	4000-35			A40A 100V G.E.	2N3055	6	2N3055		0.4Ω	6	6.8Ω	100Ω,10W	1				T60193-8
N28-12	7	10000-50	2	4000-35			A40A 100V G.E.	2N3055	6	2N3055		0.4Ω	6	6.8Ω	100Ω,10W	1				T60193-9
N32-11	7	5000-75	2	4000-35			A40B G.E.	2N3055	9	2N3055	40313 RCA	0.67Ω	9	5.6Ω	250Ω,10W	2				T60193-10
N36-10	7	5000-75	2	2650-50			A40B G.E.	37792A	9	37792A		0.83Ω	9	5.6Ω	250Ω,10W	2				T60193-11
N40-9	7	5000-75	2	2650-50			A40B G.E.	37792A	6	37792A		0.5Ω	6	6.8Ω	250Ω,10W	2				T60193-12
N48-8.5	7	5000-75	2	1350-75			A40B G.E.	37792A	7	37792A		0.67Ω	7	5.6Ω	400Ω,10W	2				T60193-13
N3-36	8	46000-15	2	25000-5			IN2128A IRC	2N3055	11	2N3055	40250 RCA	0.25Ω	11	3.9Ω	10Ω,10%,2W	1				T60181-1
N5-35	8	35000-20	2	18500-10			IN2128A IRC	2N3055	11	2N3055		0.25Ω	11	3.9Ω	15Ω,5W	1				T60181-30
N6-34	8	35000-20	2	18500-10			IN2128A IRC	2N3055	11	2N3055		0.25Ω	11	3.9Ω	15Ω,5W	1				T60181-2
N9-32	8	35000-20	2	18500-10			IN2129A IRC	2N3055	12	2N3055		0.33Ω	12	3.9Ω	30Ω,10W	1				T60181-3
N12-28	8	29000-25	2	14000-15			IN2129A IRC	2N3055	12	2N3055		0.4Ω	12	3.9Ω	50Ω,10W	1				T60181-4
N15-28	8	23500-35	2	10000-20			IN2129A IRC	2N3055	14	2N3055		0.4Ω	14	3.3Ω	50Ω,10W	1				T60181-5
N18-25	8	23500-35	2	10000-20			IN2129A IRC	2N3055	13	2N3055		0.5Ω	13	3.3Ω	50Ω,10W	1				T60181-6
N21-22	8	23500-35	2	8000-25			IN2129A IRC	2N3055	11	2N3055		0.5Ω	11	3.9Ω	100Ω,10W	1				T60181-7
N24-20	8	15000-50	2	8000-25			IN2130A IRC	2N3055	11	2N3055		0.4Ω	11	3.9Ω	100Ω,10W	1				T60181-8
N28-19	8	15000-50	2	7000-35			IN2130A IRC	2N3055	13	2N3055		0.67Ω	13	3.3Ω	100Ω,10W	1				T60181-9
N32-18	8	15000-50	2	7000-35			IN2130A IRC	2N3055	14	2N3055	40313 RCA	0.67Ω	14	3.3Ω	250Ω,10W	2				T60181-10
N36-17	8	7750-75	2	4000-50			A40B G.E.	37792A	16	37792A		0.83Ω	16	2.7Ω	250Ω,10W	2				T60181-11
N40-15	8	7750-75	2	4000-50			A40B G.E.	37792A	13	37792A		0.83Ω	13	3.3Ω	250Ω,10W	2				T60181-12
N48-12	8	5750-100	2	4000-50			A40B G.E.	37792A	11	37792A		0.83Ω	11	3.9Ω	400Ω,10W	2				T60181-13

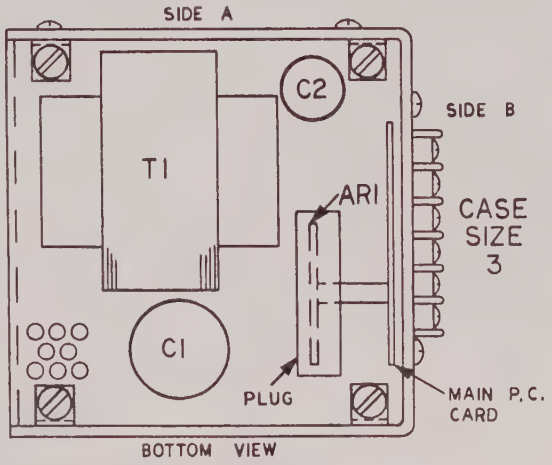
UNLESS OTHERWISE SPECIFIED EACH ITEM QTY. 1. THE PARTS ON THIS LIST ARE SUBJECT TO CHANGE WITHOUT NOTICE.



MAIN PRINTED CIRCUIT CARD
USED IN SIZE 1-2-3.





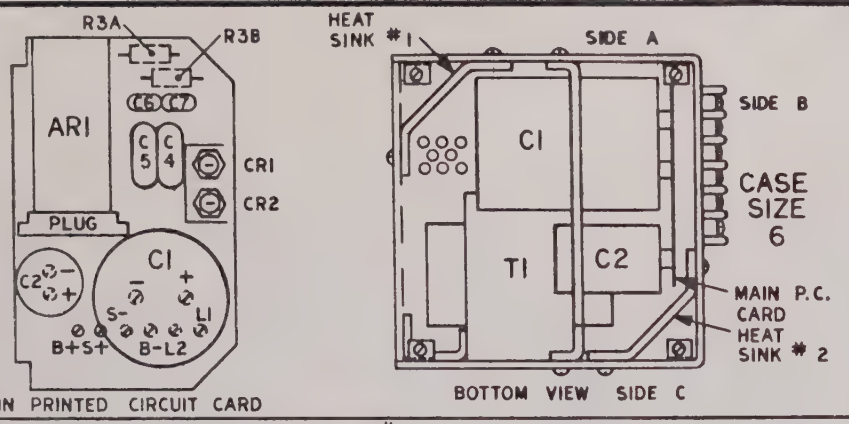


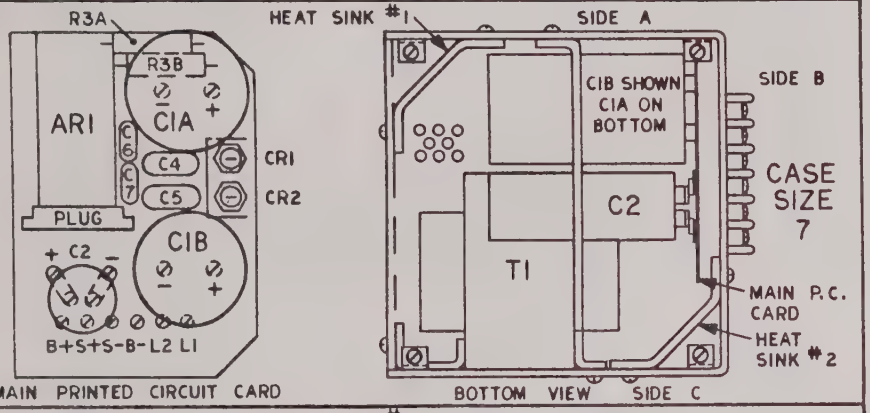
DISASSEMBLY INSTRUCTIONS

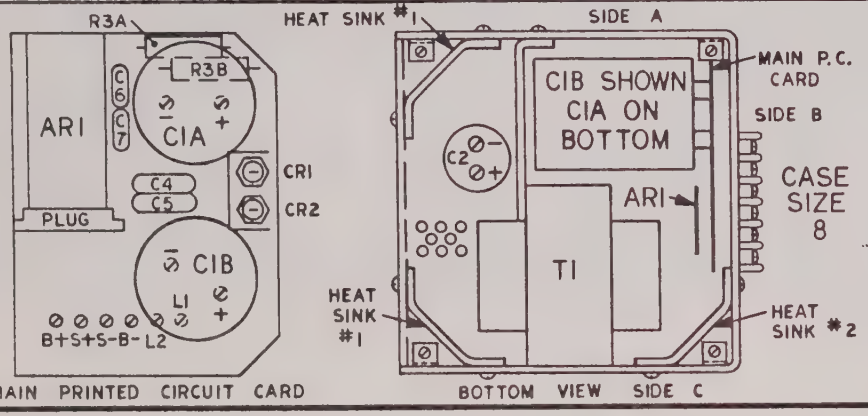
A. COVER REMOVAL:
1. REMOVE ALL SCREWS HOLDING PERFORATED COVER AND CAREFULLY SLIDE IT OFF.

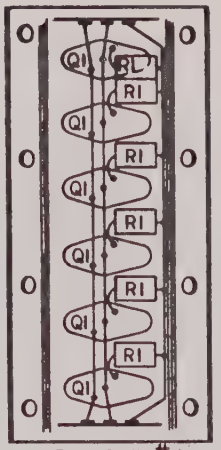
B. AMPLIFIER ARI REMOVAL:
1. CAREFULLY REMOVE PLUG FROM AMPLIFIER.
2. REMOVE SCREW TO AMPLIFIER ASSEMBLY VISIBLE THRU HOLE IN SIDE B. (SPACER REMAINS WITH AMPLIFIER.)
3. FROM INSIDE OF UNIT REMOVE REMAINING SCREW HOLDING AMPLIFIER. THIS SPACER TO STAY WITH MAIN P.C. CARD.

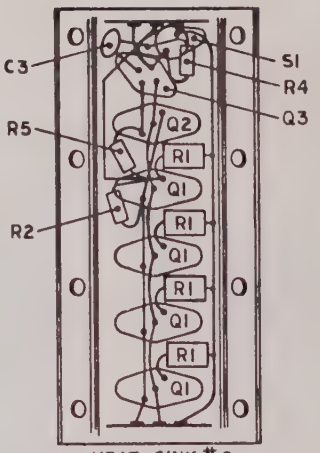
C. ELECTRONIC ASSEMBLY REMOVAL:
1. REMOVE ALL SCREWS FROM SIDE A AND SIDE B.
2. CAREFULLY SLIDE COVER OFF ASSEMBLY.











HEAT SINK REMOVAL INSTRUCTIONS:

1. REMOVE ALL PUSH-ON TERMINALS NOTING LOCATION BEFORE REMOVAL.
2. REMOVE ALL SCREWS HOLDING HEAT SINK AND CAREFULLY REMOVE HEAT SINK FROM UNIT.

NOTE: IT IS NECESSARY IN CASE SIZE 6 TO REMOVE HEAT SINK #1 AND FOLLOW ELECTRONIC ASSEMBLY REMOVAL INSTRUCTIONS BEFORE REMOVING HEAT SINK #2.

DISASSEMBLY INSTRUCTIONS:

A. COVER REMOVAL:
   1. REMOVE ALL SCREWS HOLDING PERFORATED COVER AND CAREFULLY SLIDE IT OFF.

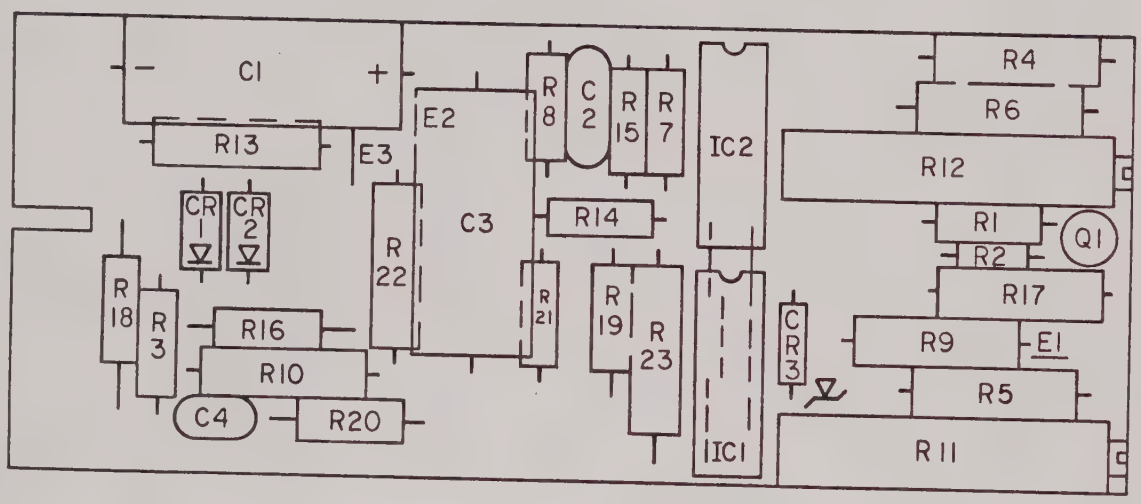
B. AMPLIFIER ARI REMOVAL:
   1. PUSH TOP OF ARI AWAY FROM MAIN P.C. CARD SO THAT PLASTIC SPACER WILL POP OUT OF HOLE IN BOARD ALLOWING EASY REMOVAL OF ARI BY GENTLY PULLING IT UPWARD OUT OF ITS PLUG.

C. HEAT SINK REMOVAL:
   1. SEE HEAT SINK REMOVAL INSTRUCTIONS.

D. ELECTRONIC ASSEMBLY REMOVAL:
   1. REMOVE ALL SCREWS FROM SIDE A, SIDE B AND SIDE C.
   2. CAREFULLY SLIDE COVER OFF ASSEMBLY.

MODEL	CASE SIZE	C1 uf.-V	C2 uf.-V	C3 C6 C7	C4 C5	CR1-CR2	Q1	QTY.	Q2	Q3	R1 5W	QTY.	R2 10%, 1/2W	R3	R4	R5	S1	T1
N3-5.3	4	8000-15	3000-15	0.01UF.-400V	0.1UF.-200V	408B WEST.	2N3055	2	40250 RCA	—	0.33Ω	2	27Ω	68Ω, 10%, 1W	15Ω, 10%, 1/2W	—	STEMCO TYPE A510 CLOSE ON RISE AT 284°F OPEN AT 255°F	T60003-1A
N5-5.2	4	8000-15	3000-15			408B WEST.	2N3055	2	40250 RCA		0.33Ω	2	27Ω	68Ω, 10%, 1W				T60003-30A
N6-5.2	4	6500-20	3000-15			408B WEST.	2N3055	2	40250 RCA		0.33Ω	2	27Ω	68Ω, 10%, 1W				T60003-2A
N9-4.4	4	5000-25	3000-15			408B WEST.	2N3055	2	40250 RCA		0.4Ω	2	27Ω	180Ω, 10%, 1W				T60003-3A
N12-4.0	4	4000-35	3000-15			407B WEST.	2N3055	2	40250 RCA		0.4Ω	2	27Ω	270Ω, 10%, 1W				T60003-4A
N15-3.5	4	4000-35	1000-25			407B WEST.	2N3055	2	40250 RCA		0.4Ω	2	27Ω	330Ω, 10%, 1W				T60003-5A
N18-3.2	4	4000-35	1000-25			407B WEST.	2N3055	2	40250 RCA		0.5Ω	2	27Ω	390Ω, 10%, 2W				T60003-6A
N21-2.9	4	2650-50	1000-25			407B WEST.	2N3055	2	40250 RCA		0.5Ω	2	27Ω	470Ω, 10%, 2W				T60003-7A
N24-2.7	4	2650-50	500-50			407B WEST.	2N3055	2	40250 RCA		0.67Ω	2	27Ω	560Ω, 10%, 2W				T60003-8A
N28-2.5	4	2650-50	500-50			407B WEST.	2N3055	2	40250 RCA		0.67Ω	2	27Ω	680Ω, 10%, 2W				T60003-9A
N32-2.2	4	1350-75	500-50			407D WEST.	2N3055	2	40313 RCA		0.67Ω	2	27Ω	820Ω, 10%, 2W				T60003-10A
N36-2.0	4	1350-75	500-50			407D WEST.	37792A	2	40313 RCA		0.83Ω	2	27Ω	1000Ω, 10%, 2W				T60003-11A
N40-1.8	4	1350-75	500-50			407D WEST.	37792A	2	40313 RCA		0.83Ω	2	27Ω	1000Ω, 5W				T60003-12A
N48-1.7	4	1000-100	150-150			407D WEST.	37792A	2	40313 RCA		0.83Ω	2	27Ω	1000Ω, 5W				T60003-13A
N3-11	5	18000-15	5500-15			409B WEST.	2N3055	5	40250 RCA	2N3053 RCA	0.4Ω	5	12Ω	12Ω, 10%, 2W		390Ω, 10%, 1/2W		T60187-1
N5-10.5	5	14750-20	5500-15			409B WEST.	2N3055	5	40250 RCA		0.4Ω	5	12Ω	39Ω, 10%, 2W				T60187-30
N6-9	5	14750-20	5500-15			409B WEST.	2N3055	4	40250 RCA		0.4Ω	4	15Ω	39Ω, 10%, 2W				T60187-2
N9-8	5	10000-25	5500-15			409B WEST.	2N3055	4	40250 RCA		0.4Ω	4	15Ω	68Ω, 10%, 2W				T60187-3
N12-7.3	5	9000-35	5500-15			409B WEST.	2N3055	4	40250 RCA		0.5Ω	4	15Ω	100Ω, 10%, 2W				T60187-4
N15-6.3	5	9000-35	2000-25			409B WEST.	2N3055	3	40250 RCA		0.4Ω	3	18Ω	150Ω, 5W				T60187-5
N18-5.8	5	9000-35	2000-25			408B WEST.	2N3055	3	40250 RCA		0.5Ω	3	18Ω	150Ω, 5W				T60187-6
N21-4.7	5	5000-50	2000-25			408B WEST.	2N3055	3	40250 RCA	—	0.5Ω	3	18Ω	250Ω, 5W		—		T60187-7
N24-4.6	5	5000-50	1000-50			408B WEST.	2N3055	3	40250 RCA		0.5Ω	3	18Ω	250Ω, 5W				T60187-8
N28-4.6	5	5000-50	1000-50			408B WEST.	2N3055	3	40250 RCA		0.5Ω	3	18Ω	250Ω, 5W				T60187-9
N32-3.9	5	3000-75	1000-50			407D WEST.	2N3055	4	40313 RCA		0.83Ω	4	15Ω	250Ω, 10W				T60187-10
N36-3.6	5	3000-75	1000-50			407D WEST.	37792A	3	40313 RCA		0.67Ω	3	18Ω	400Ω, 10W				T60187-11
N40-3.3	5	3000-75	1000-50			407D WEST.	37792A	3	40313 RCA		0.83Ω	3	18Ω	400Ω, 10W				T60187-12
N48-3.0	5	3000-75	500-100			407D WEST.	37792A	3	40313 RCA		0.83Ω	3	18Ω	500Ω, 10W				T60187-13

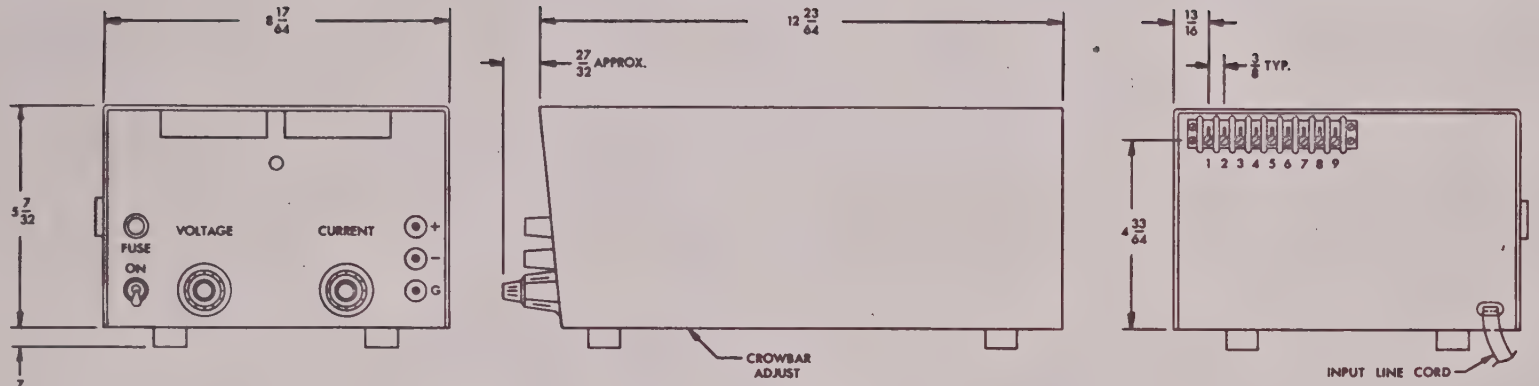
UNLESS OTHERWISE SPECIFIED EACH ITEM QTY. 1. THE PARTS ON THIS LIST ARE SUBJECT TO CHANGE WITHOUT NOTICE.



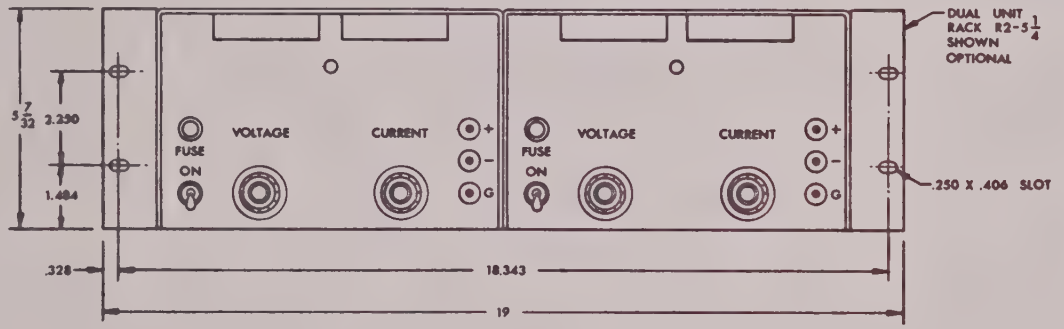
AMPLIFIER ARI
SERIES N
DELTRON INC.

MODEL	CASE SIZE	C1 uf.-V	C2 uf.-V	C3-C4 C5-C6 C7	CR1-CR2	Q1	Q2	R1 5W	R2 10%,½W	R3	R4	S1	T1
N3-0.80	1	2000-15	500-25	0.01UF.-200V	MH-69 SOLITRON	40250 RCA	2N3053	1.0Ω	180Ω	270Ω,10%,1/2W	15Ω,10%,1/2W	STEMCO TYPE A510 CLOSE ON RISE AT 230°F OPEN AT 206°F	T60125-1A
N5-0.76	1	1000-25	500-25		MH-69 SOLITRON	40250 RCA	2N3053	1.0Ω	180Ω	470Ω,10%,1/2W			T60125-30A
N6-0.74	1	1000-25	500-25		MH-69 SOLITRON	40250 RCA	2N3053	1.0Ω	180Ω	470Ω,10%,1/2W			T60125-2A
N9-0.53	1	1000-25	500-25		MH-69 SOLITRON	40250 RCA	2N3053	1.67Ω	180Ω	680Ω,10%,1/2W			T60125-3A
N12-0.53	1	1000-25	500-25		MH-69 SOLITRON	40250 RCA	2N3053	1.67Ω	180Ω	1000Ω,10%,1/2W			T60125-4A
N15-0.42	1	450-50	120-25		MH-69 SOLITRON	40250 RCA	2N3053	2Ω	180Ω	1200Ω,10%,1/2W			T60125-5A
N18-0.39	1	450-50	120-25		MH-69 SOLITRON	40250 RCA	2N3053	2Ω	180Ω	1500Ω,10%,1W			T60125-6A
N21-0.35	1	450-50	120-25		MH-69 SOLITRON	40250 RCA	2N3053	2Ω	180Ω	1800Ω,10%,1W			T60125-7A
N24-0.34	1	450-50	50-50		MH-69 SOLITRON	40250 RCA	2N3053	2.5Ω	180Ω	2200Ω,10%,1W			T60125-8A
N28-0.34	1	450-50	50-50		MH-69 SOLITRON	40250 RCA	2N3053	2.5Ω	180Ω	2700Ω,10%,1W			T60125-9A
N32-0.22	1	200-90	50-50		MH-69 SOLITRON	40313 RCA	40327 RCA	3.3Ω	180Ω	2700Ω,10%,1W			T60125-10A
N36-0.21	1	200-90	50-50		MH-69 SOLITRON	40313 RCA	40327 RCA	3.3Ω	180Ω	3300Ω,10%,1W			T60125-11A
N40-0.21	1	200-90	50-50		MH-69 SOLITRON	40313 RCA	40327 RCA	3.3Ω	180Ω	3900Ω,10%,1W			T60125-12A
N48-0.21	1	200-90	20-150		MH-69 SOLITRON	40313 RCA	40327 RCA	3.3Ω	180Ω	4700Ω,10%,1W			T60125-13A
N3-1.5	2	2000-25	1000-6		MH-69 SOLITRON	2N3055	40250 RCA	0.5Ω	47Ω	120Ω,10%,1/2W		STEMCO TYPE A510 CLOSE ON RISE AT 284°F OPEN AT 255°F	T60001-1A
N5-1.45	2	2000-25	500-25		MH-69 SOLITRON	2N3055	40250 RCA	0.5Ω	47Ω	220Ω,10%,1/2W			T60001-30A
N6-1.4	2	2000-25	500-25		MH-69 SOLITRON	2N3055	40250 RCA	0.5Ω	47Ω	220Ω,10%,1/2W			T60001-2A
N9-1.2	2	2000-25	500-25		MH-69 SOLITRON	2N3055	40250 RCA	0.67Ω	47Ω	390Ω,10%,1/2W			T60001-3A
N12-1.0	2	2000-25	500-25		MH-69 SOLITRON	2N3055	40250 RCA	0.83Ω	47Ω	560Ω,10%,1/2W			T60001-4A
N15-0.75	2	1000-50	250-25		MH-69 SOLITRON	2N3055	40250 RCA	1.0Ω	47Ω	680Ω,10%,1W			T60001-5A
N18-0.69	2	1000-50	250-25		MH-69 SOLITRON	2N3055	40250 RCA	1.33Ω	47Ω	820Ω,10%,1W			T60001-6A
N21-0.60	2	1000-50	250-25		MH-69 SOLITRON	2N3055	40250 RCA	1.33Ω	47Ω	1000Ω,10%,1W			T60001-7A
N24-0.53	2	1000-50	100-50		MH-69 SOLITRON	2N3055	40250 RCA	1.33Ω	47Ω	1000Ω,10%,1W			T60001-8A
N28-0.53	2	1000-50	100-50		MH-69 SOLITRON	2N3055	40250 RCA	1.33Ω	47Ω	1200Ω,10%,2W			T60001-9A
N32-0.51	2	1000-50	100-50		MH-69 SOLITRON	2N3055	40313 RCA	1.67Ω	47Ω	1500Ω,10%,2W			T60001-10A
N36-0.44	2	650-75	100-50		MH-69 SOLITRON	37792A	40313 RCA	1.67Ω	47Ω	1500Ω,10%,2W			T60001-11A
N40-0.37	2	650-75	100-50		MH-69 SOLITRON	37792A	40313 RCA	2.5Ω	47Ω	1800Ω,10%,2W			T60001-12A
N48-0.35	2	600-90	30-150		MH-69 SOLITRON	37792A	40313 RCA	2.5Ω	47Ω	2200Ω,10%,2W			T60001-13A
N3-3.8	3	10000-15	1000-25		MR1031A MOTOROLA	2N3055	40250 RCA	0.25Ω	47Ω	120Ω,10%,1/2W			T60002-1A
N5-3.7	3	7900-25	1000-25		MR1031A MOTOROLA	2N3055	40250 RCA	0.25Ω	47Ω	220Ω,10%,1/2W			T60002-30A
N6-3.5	3	7900-25	1000-25		MR1031A MOTOROLA	2N3055	40250 RCA	0.25Ω	47Ω	220Ω,10%,1/2W			T60002-2A
N9-3.0	3	7900-25	1000-25		MR1031A MOTOROLA	2N3055	40250 RCA	0.33Ω	47Ω	390Ω,10%,1/2W			T60002-3A
N12-2.8	3	4400-40	1000-25		MR1031A MOTOROLA	2N3055	40250 RCA	0.33Ω	47Ω	560Ω,10%,1/2W			T60002-4A
N15-2.7	3	4400-40	500-25		MR1031A MOTOROLA	2N3055	40250 RCA	0.33Ω	47Ω	680Ω,10%,1W			T60002-5A
N18-2.6	3	4400-40	500-25		MR1031A MOTOROLA	2N3055	40250 RCA	0.33Ω	47Ω	820Ω,10%,1W			T60002-6A
N21-2.2	3	3000-50	500-25		MR1032A MOTOROLA	2N3055	40250 RCA	0.4Ω	47Ω	1000Ω,10%,1W			T60002-7A
N24-2.0	3	3000-50	450-50		MR1032A MOTOROLA	2N3055	40250 RCA	0.4Ω	47Ω	1000Ω,10%,1W			T60002-8A
N28-1.9	3	3000-50	450-50		MR1032A MOTOROLA	2N3055	40250 RCA	0.5Ω	47Ω	1200Ω,10%,2W			T60002-9A
N32-1.2	3	2000-75	450-50		MH-69 SOLITRON	2N3055	40313 RCA	0.67Ω	47Ω	1500Ω,10%,2W			T60002-10A
N36-1.1	3	2000-75	450-50		MH-69 SOLITRON	37792A	40313 RCA	0.67Ω	47Ω	1500Ω,10%,2W			T60002-11A
N40-1.1	3	2000-75	450-50		MH-69 SOLITRON	37792A	40313 RCA	0.67Ω	47Ω	1800Ω,10%,2W			T60002-12A
N48-1.0	3	2000-75	80-150		MH-69 SOLITRON	37792A	40313 RCA	0.83Ω	47Ω	2200Ω,10%,2W			T60002-13A

UNLESS OTHERWISE SPECIFIED EACH ITEM QTY. 1. THE PARTS ON THIS LIST ARE SUBJECT TO CHANGE WITHOUT NOTICE.



NOTE: MTG. OF SINGLE UNIT CENTERED IN 19" RACK ALSO AVAILABLE. (SINGLE UNIT RACK R1-5 1/4 OPTIONAL)



ALL TOLERANCES ± 3/64

1	B+	POSITIVE OUTPUT	NORMALLY LINKED
2	S+	POSITIVE SENSE	
3	V+	VOLTMETER POSITIVE	
4	N	CURRENT PROGRAMMING	NORMALLY LINKED
5	I	CURRENT PROGRAMMING	
6	GND	CHASSIS GROUND	
7	V−	VOLTAGE PROGRAMMING	
8	S−	NEGATIVE SENSE	NORMALLY LINKED
9	B−	NEGATIVE OUTPUT	

AP. MFG. 0

C-13676

DIMENSIONS ARE IN INCHES AND INCLUDE THICKNESS OF PLATING. DO NOT SCALE DRAWING.
ALL EXTERNAL THREADS TO BE CLASS 2A (NEW STD) ALL EXTERNAL THREADS TO BE CLASS 3B (NEW STD) UNLESS OTHERWISE SPECIFIED.

THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF DELTRON, INCORPORATED, PHILADELPHIA, PA., AND SHALL NOT BE REPRODUCED, OR COPIED, OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS OR DEVICES WITHOUT THE WRITTEN APPROVAL OF DELTRON, INCORPORATED, SEVERE PENALTIES.

SCALE:

OUTLINE DWG FOR SP SERIES

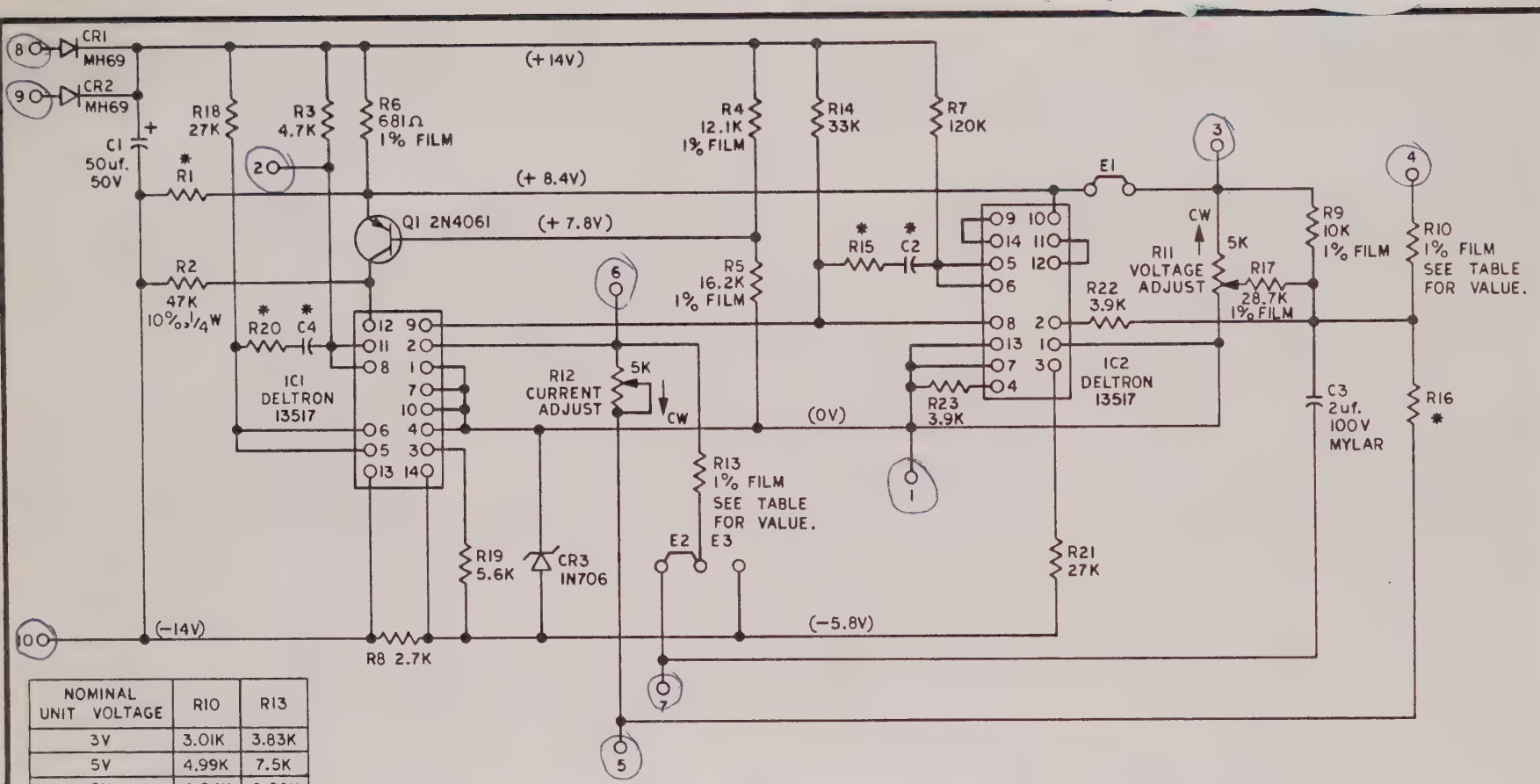
FIRST MADE FOR 5 1/4 HALF RACK USED ON K AMP

DESIGN BY: TRACED BY:

FURNISHED BY K.G. KLUGE & CHECKED BY:

Deltron Inc. PHILA. 33, PA.

C 13676

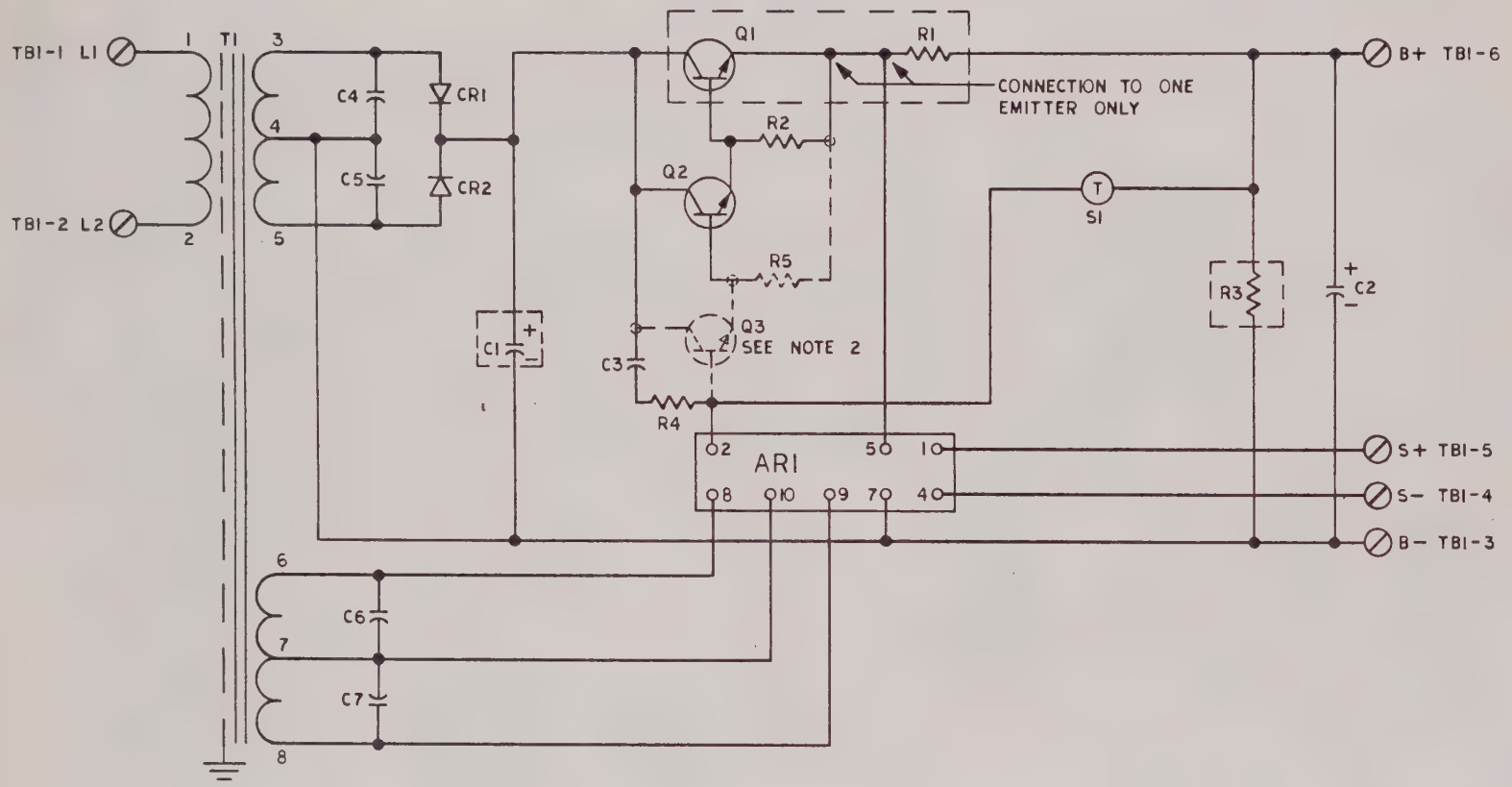


NOMINAL UNIT VOLTAGE	R10	R13
3V	3.01K	3.83K
5V	4.99K	7.5K
6V	6.04K	9.09K
9V	9.09K	14.7K
12V	12.1K	21.5K
15V	15.0K	26.1K
18V	17.8K	31.6K
21V	21.0K	38.3K
24V	23.7K	42.2K
28V	28.0K	51.1K
32V	31.6K	56.2K
36V	35.7K	68.1K
40V	40.2K	75K
48V	47.5K	90.9K

NOTES:

1. RESISTOR VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/2 WATT ± 10 % UNLESS OTHERWISE NOTED.
3. CAPACITOR TOLERANCES: ELECTROLYTIC −10 % +100 %; MYLAR ± 20 % ; UNLESS OTHERWISE NOTED.
4. SYMBOLS: —O INDICATES TERMINAL ON PRINTED CIRCUIT BOARD. * SELECTED IN TEST ONLY IF REQUIRED.
5. E1-E2 : LINKS #22 AWG.
6. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT : 115Vac, 60Hz; OUTPUT : NOMINAL Vdc, NO LOAD INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC. DC MEASUREMENTS TAKEN WITH 20,000 OHMS / V VOLTMETER BETWEEN S+ AND INDICATED POINTS IN PARENTHESES.

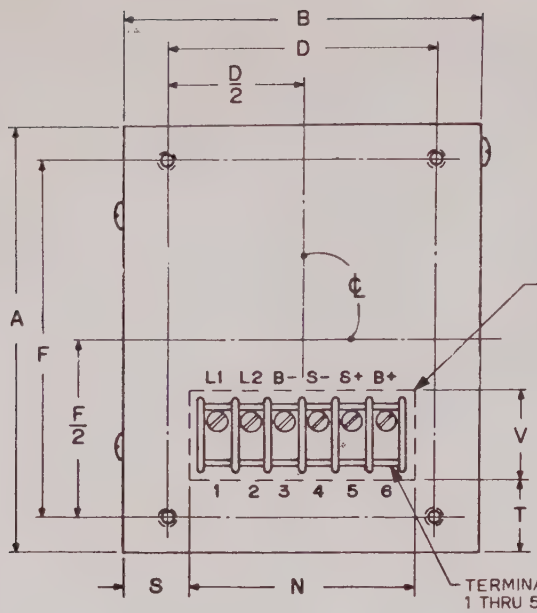
SCHEMATIC DIAGRAM
ARI N SERIES
DELTRON INC.



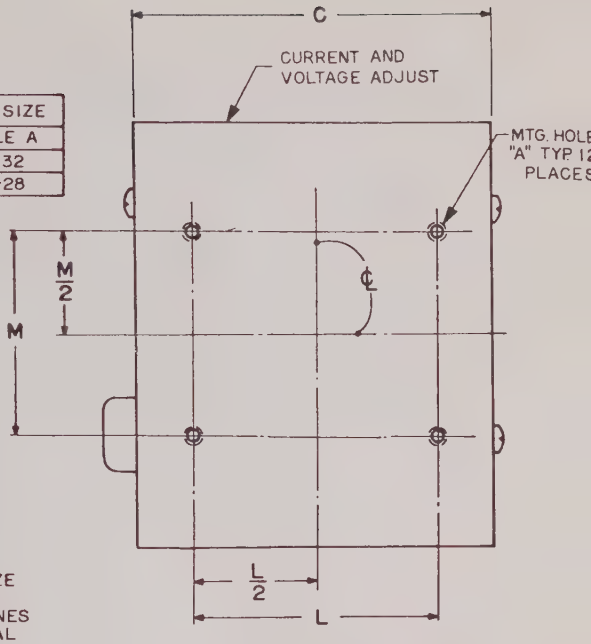
NOTES:

1. FOR VALUES OF COMPONENTS SEE LIST OF PARTS.
2. FOR UNITS THAT DO NOT USE Q3 & R5 CONNECT BASE OF Q2 TO TERMINAL 2 OF AMPLIFIER ARI.
3. DOTTED COMPONENTS USED ONLY WHEN CALLED FOR ON PARTS LIST.
4. COMPONENTS WITHIN DOTTED AREAS ARE WIRED IN PARALLEL WHEN LIST OF PARTS INDICATES Q1, R1, R3, C1 SUFFIXED WITH LETTERS A, B, ETC.

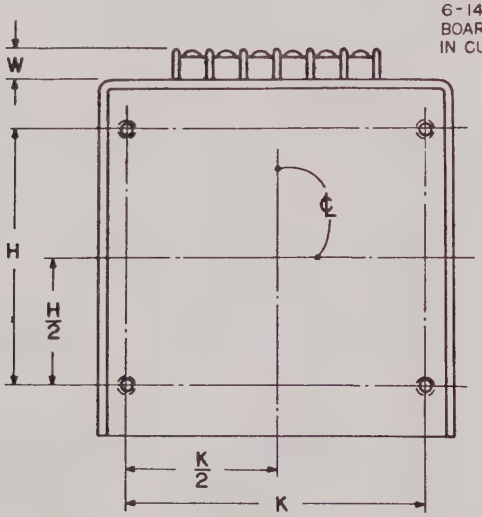
SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY
SERIES N
DELTRON INC.



MTG. HOLE SIZE	
SIZE	HOLE A
1 THRU 5	10-32
6 THRU 8	1/4-28



TERMINAL BOARD DETAILS	
SIZE	SCREW SIZE
1 THRU 5	5-40
6 THRU 8	8-32



MOUNTING DETAILS

Light weight, rugged construction and captive mounting hardware on three surfaces make the Deltron Series N Modules extremely easy to mount in a Deltron rack adapter or in any custom installation.

The dimensions and locations of mounting holes for the case size of the power modules you require are tabulated below. By relating the lettered dimensions of the drawing to the table, all the data required to mount Series N Modules is obtained.

	DIMENSIONS *													
SIZE	A	B	C	D	F	H	K	L	M	N	S	T	V	W
1	4-3/4	3-1/4	3-1/4	2-1/2	3-31/32	2-5/32	2-1/2	2-1/32	2-3/16	2-15/32	7/32	13/16	1	27/64
2	4-3/4	4	4	3	3-31/32	2-29/32	3-1/4	2-25/32	2-3/16	2-15/32	3/4	13/16	1	27/64
3	4-3/4	5	5	4	3-31/32	3-29/32	4-3/16	3-25/32	2-3/16	2-15/32	1-1/4	13/16	1	27/64
4	4-3/4	6	6	5	3-31/32	4-29/32	5-3/16	4-25/32	2-3/16	2-15/32	1-3/4	13/16	1	27/64
5	4-3/4	7	7	6	3-31/32	5-29/32	6-3/16	5-25/32	2-3/16	2-15/32	2-1/4	13/16	1	27/64
6	8-1/4	7	7	5	7-3/8	5 7/8	6 1/8	5-45/64	4-3/4	3-21/32	5/8	1-1/32	1-7/16	41/64
7	8-1/4	7-3/4	7-3/4	6	7-3/8	6-5/8	6-7/8	6	4-3/4	3-21/32	1-3/8	1-1/32	1-7/16	41/64
8	8-1/4	9	9	7	7-3/8	7-7/8	8-1/8	6-3/4	4-3/4	3-21/32	2-21/32	1-1/32	1-7/16	41/64

*Accessory Crowbar mounts above terminal block and protrudes 1-5/8 inches from the mounting surface.

CONTROLS

The output voltage and cutback current limit controls are screwdriver adjustments accessible through holes in the top of the unit. Clockwise rotation of the control increases the output voltage or the current limiting value.

The output voltage may be set anywhere within plus and minus 5 percent of the nominal voltage. To adjust the current limit control to the maximum allowable value, rotate the control fully clockwise and set the output voltage of the supply to minimum (5% less than nominal). Load the power supply to a current 5% in excess of the rated current at the line frequency and the maximum ambient temperature to be encountered. Turn the current control counterclockwise until the power supply just begins to go out of regulation.

The current limit control may be set at any lower value (more counterclockwise) than above to protect externally connected loads.

THEORY OF OPERATION

Referring to Page 11, the supply consists of an unregulated full wave DC Supply with a capacitance filter, a series regulator, Q1 (may be paralleled transistors), darlington driver(s), Q2 (& Q3) and an error amplifier AR1 (Diagram Page 12).

A portion of the output voltage is compared with a reference voltage in the amplifier to form an error signal. The error is amplified by the integrated circuits to provide a drive signal for the darlington driver(s) in the series regulator at terminal 2 of the error amplifier. The drive and thus the voltage drop across the regulator adjusts to reduce the error voltage to a few microvolts and thus the output to its regulated value.

A voltage proportional to the output current of the supply is measured across one emitter resistor, R1, Page 11, and compared in the error amplifier with a portion of the output voltage.

When the output current limit setting is exceeded, the current signal dominates, causing a reversal of the error signal. This error signal is amplified in the integrated circuits and causes a decrease in the drive at pin 2 of the amplifier to a value that causes the series regulator to limit the output current. When the overcurrent is removed, the drive again returns to the value required to regulate the output voltage.

A separate regulated bias supply consisting of an unregulated full wave DC input with capacitor filter, a series regulator and an error amplifier is included on the AR1 error amplifier printed circuit board. This regulated supply provides bias current for the reference, the integrated circuit error amplifiers and the drive for the darlington driver in the series regulator.

MAINTENANCE AND TROUBLESHOOTING

Most circuit malfunctions are caused by faulty semiconductors. One of the most common failures is a collector to emitter short circuit in a pass transistor, Q1. This will be evidenced by the rise of the output voltage above the regulated value,

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